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CIVIL ENGINEERING.

On the Expansive Working of Steam in Locomotives. By DANIEL KINNEAR CLARK, C. E.—(*With a Plate.*)*

[Abstract of a Paper read at the Institution of Mechanical Engineers.]

In locomotives, the adoption of a low standard of boiler pressure is the first obstacle in the way of carrying out the expansive working of steam, as the more expansively the steam is worked, the less is the work done by the engine. The second obstacle is, in many locomotives, the exposure of the cylinders, by which the steam within is partially condensed. Moreover, the proportion of steam so condensed increases with the degree of expansion, in a very formidable ratio, which will be afterwards submitted to examination.

The object of this paper is to show at what rate in practice the efficiency of steam is increased by expansive working in locomotives with the best existing arrangements of cylinders, valves, and valve-gear, and to point out the conditions on which expansive action may be most successfully carried out.

I.—*Of the Action and Capabilities of the Link-Motion.*—The action of the valves in the "distribution" of the steam (a term borrowed from the French) is regulated by three elements, the lap, the lead, and the travel.

* From the London Civil Engineer and Architect's Journal, September, 1852.

When these are given, the point of the stroke of the piston at which the steam is admitted to the cylinder, cut off, exhausted, and compressed or shut up, are all deducible by model, by diagram, or by calculation. This can be done, whether the valve derives its motion from a single eccentric, or from a link-motion, as the motion of the valve is virtually the same in both cases. The way in which the valve is caused to cut off or suppress the steam earlier by the link-motion, is by *shortening the travel of the valve;* this is accomplished by means of the reversing gear, in such a manner that whatever be the reduction of travel communicated to the valve, the lead is always at least the same as in full gear, and with the shifting-link is rather increased.

In working out the four changes in the distribution of the steam, already enumerated, which regulate the movements of the steam, the action of the link-motion is such that, 1st, the sooner the steam is cut off, the sooner it is exhausted, the sooner the port is closed for exhaustion, and the sooner the port is opened for the admission of steam.

2d, That though every change is made earlier—as measured in parts of the stroke—there is less difference in the position of the points of exhaust, compression, and admission, than in that of the cutting off. Consequently, the shorter the admission, the longer is the expansion, as the exhaust point does not recede so much as the point of cutting off.

3d, That by the shifting link-motion, the steam may be cut off at from $\frac{1}{8}$th to $\frac{1}{4}$th of the stroke.

4th, That though the exhaust takes place earlier for every increase of expansion, it does not in any case take place within the first half of the stroke. For mid-gear it occurs in fact at 54 per cent. of the stroke; and the steam is expanded into $3\frac{1}{2}$ times the length of stroke at which it is cut off.

5th, That the period of compression, increasing as the admission is reduced, amounts to about one-half stroke in mid-gear.

6th, That the pre-admission of the steam, not above 1 per cent. of the stroke in full gear, reaches about 10 per cent. in mid-gear.

These results prove that the link-motion is capable of cutting off steam as early in the course of the stroke as can ever be advisable in practice.

It has been seen that the earlier the steam is cut off, the *earlier also it is exhausted;* until in mid-gear it may be released at half stroke. This has been deemed a serious objection to the use of link-motions for high expansion, as it is supposed to lead to a serious loss of expansive action, by exhausting prematurely. This loss is, however, a mere trifle in practice. The escape of the steam is by no means instantaneous, as is easily proved by the diagrams in fig. 1 (Plate I.), taken by the writer from the *Caledonia*, passenger engine, by means of M'Naught's Indicator, at speeds of 1 and 2 miles per hour. The numbers in the diagrams indicate the number of the sector notches to which the reversing lever was placed, while the diagrams were described. Referring to No. 1, taken under full gear, the steam is shown to be admitted to the cylinder a little before the beginning of the stroke, at A. From B to C the steam is admitted, at C shut off, expanded to D, and thence exhausted to E, the end of the

stroke, whence it continues to be exhausted till the point F in the return stroke, where the exhaust port is closed. Now, the exhaust line, D E, shows that nearly all the period of exhaust for the steam stroke is employed for the complete evacuation of the steam. And if this be the case for speeds of 1 and 2 miles an hour, it is much more so for the regular working speeds of trains. To select from a very admirable series of Indicator Diagrams, with copies of which the writer has been favored by Mr. Daniel Gooch, by whom they were taken from the cylinder of the *Great Britain*, locomotive, on the Great Western Railway, the figs. 4 and 5 contain diagrams taken at 17 and 55 miles per hour respectively, under the 1st, 3d, and 5th notches of the sector. The following are the conditions of the valve motion of this engine, when the diagrams were taken:

State of the Valves of the "Great Britain" Locomotive, G. W. R.

Cylinder, 18 × 24 inches; wheel, 8 feet; lap, 1¼ inch; constant lead, ⅜-inch; travel in full gear, 4⅛ inches; blast orifice, 5½ inches diameter.

No. of Notch.	Position of Points of Distribution.			Period of exhaust during steam stroke.
	Cutting off.	Exhaust.	Compression.	
	Inches.	Inches.	Inches.	Inches.
1	16	21⅜	3	2⅜
3	11¾	19¼	5	4¼
5	7	17⅜	7½	6⅜

On the diagrams the points of cutting off and exhaust are marked, and the steam line falls only very gradually during the period of exhaust, and especially at the high speeds. The expansion curves are shown by dotted lines, A, B, C, figs. 4 and 5, continued to the end of the stroke. These are easily calculated in terms of the relative volumes of steam, from the pressures indicated at the points of exhaust, and are such as would have been described had the exhaust been delayed till the end of the stroke. The shaded areas, A, B, C, inclosed between these dotted curves and the curves actually described, express the *power lost* by exhausting the steam *before the stroke is completed*. Averaging them for the whole stroke, they are as follows:

	Low Speeds.	High Speeds.
1st Notch,	¾ lb. per in. loss.	1 lb. per in. loss.
3d "	2¼ lb. "	1 lb. "
5th "	3⅛ lb. "	⅜ lb. "

The losses at high speeds are very small, merely nominal; and curiously enough, the loss by the *earlier* exhaust of the 5th notch is actually less than that under the 1st notch. The losses are of course greater at the low speeds; but even then, in the 1st notch, which is the only notch employed at very low speeds, the loss does not amount to 1 lb. per inch. The 3d and 5th notches are employed only at speeds much above 17 miles per hour, and the loss by them is of no practical moment.

Upon the whole, it follows that the possible *loss by the early exhaust* yielded by the link-motion is of *no importance*. On the contrary, it can

be proved to be *beneficial*, as an early exhaust is at high speeds essential to a perfect exhaust during the return-stroke. It plainly appears, therefore, that with the existing arrangements of locomotives, any attempts to eke out the power of the steam-line, by prolonging the expansion materially beyond what is accomplished by an ordinary valve and link-motion, are not only useless, but highly prejudicial.

Another objection to the link-motion is, that the steam is injuriously *wire-drawn* by it when under great expansion. Hence the numerous attempts to supersede the link by the employment of a separate expansion valve. The diagrams, fig. 5, may be referred to as examples of wire-drawing by the link. They were taken nearly consecutively with one opening of the regulator; and it is clear that the steam attained fully as high a pressure in the cylinder under the 5th notch as under the 1st. The pressure falls considerably towards the point of cutting off, but from the form of the steam-line, it is plain that very little additional steam is admitted for an inch or two before the cutting-off actually takes place. The most of the steam is admitted at the higher pressure, and in fact a partial expansion of the steam already admitted takes place for some distance before the expansion nominally begins. Thus the *wire-drawing* is, to a great extent, equivalent to an *earlier cutting-off*, and a greater degree of expansion. The whole possible loss by wire-drawing is comprised within the dotted line D, added to the diagram, which is merely an extension of the expansion curve to meet the steam line, drawn horizontally to represent a free admission up to an imaginary point, D, of cutting off, 5 inches from the beginning of the stroke. This shaded area, D, amounts exactly to a mean loss upon the whole stroke of *one pound per square inch*, by *wire-drawing*, under high expansion. For the 1st and 3d notches, the amount of loss by wire-drawing must obviously be still less; and, in short, the objection of *wire-drawing by the link-motion*, when of liberal proportions, is of *no practical weight*.

Another objection to the link-motion, and apparently the most formidable one, is the large fraction of power neutralized by the *compression* of the exhaust steam, and which increases with the degree of expansion. Compression, however, involves no loss of efficiency; for as by compression a quantity of steam is incidentally reserved and raised to a higher pressure, it gives out the power so expended in compressing it, during the next steam stroke, just as a compressed spring would do in the recoil. But, apart from this general argument, the actual efficiency of the steam in the cylinder, with and without compression, may be exactly estimated. The most direct method of doing so is, to find the quantities of water consumed as steam for one stroke, under the two conditions, and to compare them with the relative effective mean pressures. It will suffice to analyze, as an example, the high speed diagram, fig. 5, under the 5th notch, No. 5. The volume of steam admitted is measured by the product of the area of the piston, (254·47 in.,) and the period of admission, *plus* the total clearance in the cylinder and steam passage; the clearance being measured for simplicity in inches of stroke, we have $7 + 1{\cdot}8 = 8{\cdot}8$ inches, for the total volume admitted. The pressure of the steam when cut off is 65 lbs., for which the relative volume of water is 359. There-

fore, the volume of water as steam, or the water equivalent of the steam admitted, is

$$\frac{254{\cdot}47 \times 8{\cdot}8}{359} = 6{\cdot}24 \text{ cubic inches.}$$

From this is to be deducted the quantity of steam reserved by compression; the volume so reserved is measured by the period of compression, *plus* the clearance ($7{\cdot}5 + 1{\cdot}8 = 9{\cdot}3$), and the pressure at the point of compression is 8 lbs., for which the relative volume is 1125. Then the water equivalent of the reserved steam is—

$$\frac{254{\cdot}47 \times 9{\cdot}3}{1125} = 2{\cdot}10 \text{ cubic inches;}$$

subtracting, there remains $6{\cdot}24 - 2{\cdot}10 = 4{\cdot}14$ cubic inches of water as steam, actually expended for one stroke of the piston.

Were there to be no reservation of exhaust steam by foreclosing the exhaust port, the whole area of resistance by compression would be removed, and there would be a reserve of steam of atmospheric pressure equal in volume to the clearance only. The relative volume of atmospheric steam is 1669, and the water equivalent of the reserve would be

$$\frac{254{\cdot}47 \times 1{\cdot}8}{1669} = 0{\cdot}27 \text{ cubic inches;}$$

the expenditure per stroke would be $6{\cdot}24 - 0{\cdot}27 = 5{\cdot}97$ inches of water.

	Per Inch.
Now the positive mean pressure during the steam stroke, as indicated, is	40·9 lbs.
And the mean resistance by compression is . .	11·5 "
Thus the effective mean pressure is . . .	29·4 "

This effective mean pressure of 29·4 lbs. is maintained by a consumption of 4·14 inches of water per stroke; and it has just been found that with the compression removed, the positive mean pressure of 40·9 lbs. per inch would be maintained by a consumption of 5·97 inches of water per stroke. The effective pressure created per cubic inch of water is therefore,

In actual practice . . $\frac{29{\cdot}4}{4{\cdot}14} = 7{\cdot}1$ lbs.

And would be by removing compression $\frac{40{\cdot}9}{5{\cdot}97} = 6{\cdot}9$ lbs.

These quantities are expressions of the relative efficiency of steam employed with and without compression; they are virtually identical, and show that the resistance by compression in the cylinder, due to the action of the link-motion, does not in the slightest degree impair the efficiency of the steam.

The last objection to the use of the link, requiring notice, is that at *high speeds* considerable *back exhaust pressure* is created. The amount of this is very various, and it depends also on circumstances for which the link-motion is not responsible; such as a deficiency of inside lead (which is regulated by the lap), small ports, a small blast-orifice, and imperfect protection of the cylinder. It suffices on the present occasion to point to what can be done by superior arrangements, as exemplified in the diagram, fig. 5, taken from the *Great Britain*. The cylinders of this engine are in a manner suspended in the smoke box, and thoroughly protected; the steam ways are very large, 13×2 inches, being in area about $\frac{1}{10}$th of the cylinder; the exhaust passage is very direct; and the blast-orifice is $5\frac{1}{2}$ inches diameter, or about $\frac{1}{11}$th of the area of cylinder. As a whole, these proportions are superior to those of any other engines with which the writer is acquainted; and the diagrams prove that the per centages of back exhaust pressure, in terms of the positive mean pressure, at 55 miles per hour, are—

For the 1st notch, ...	$8\frac{3}{4}$ per cent.
For the 3d notch, ...	$5\frac{1}{2}$ per cent.
For the 5th notch, ...	nothing.

Better results than these should not in practice be required, for when locomotives are adapted to their work, and running at high speeds, they ought not to require an admission of steam above half stroke. However, the area of blast-orifice rules the back exhaust pressure; and, when the cylinder is duly proportioned to the boiler, it is quite practicable, by a few modifications in detail, still further to increase the orifice, sufficiently to banish all traces of back pressure of exhaust at all practicable speeds.

II.—*Of the Rate of Efficiency of Steam worked Expansively in the Locomotive, by the Link-Motion.*—To determine this ratio experimentally, under the actual circumstances of clearance, wire-drawing, and back pressure, the writer has analyzed twenty-six of the indicator diagrams from the *Great Britain*, already referred to, taken at speeds of 15 to 56 miles per hour, of which the figures are examples. The following table contains in the first nine columns an analysis of these diagrams; the effective horse powers, column 10, are estimated in terms of the diameter and stroke of cylinder, the diameter of the wheel, and the effective mean pressures in the 9th column. The water equivalents, columns 11, 12, and 13, are estimated from the indicated pressures and the period of the distribution for each notch, in the way already exemplified. The expenditure of steam per hour, column 14, is deduced from column 13, in terms of the speed, the cylinder, and the wheel; and, dividing that by the effective horse power, we have the contents of column 15 in inches, and of column 16 in pounds. Column 17 contains the coke consumed per horse power per hour, deduced for the several diagrams from the consumption of water, column 16, allowing 1 lb. of coke to evaporate 8 lbs. of water.

Referring to the contents of the last two columns of this table, it is obvious that the consumption of water as steam, or of coke, for a given amount of work done, becomes less the more expansively the steam is

Results from Indicator Diagrams, taken from the Great Britain, Locomotive, G. W. R., in 1850.

No. of Diagram.	Speed of Engine in miles per hour.	Indicated steam pressure in cylinder in lbs. per square inch.							Effective horse power indicated.	Water equivalents.						Coke consumed per effective H. P. per hour, allowing 1 lb. for 8 lb. of water.
		Maximum pressure during admission.	Positive mean pressure.	Back pressures.				Effective mean pressure.		Total Admitted for one stroke, meas'd. from diag'm.	Reserved by Compression	Actually expended during 1 steam stroke.	Actually expended per hour.	Actually expended per effective horse power per hour.		
				Exhaust.	Compression	Sum of back pressures. Pressure.	Sum of back pressures. Per cent of positive steam pressure									
	Miles.	lbs.	lbs.	lbs.	lbs.	lbs.	per cent.	lbs.	h. p.	cu. in.	cu. in.	cu. in.	cu. ft.	cu. in.	lbs.	lbs.
1	15	70	63·8	1·6	2·4	4·0	6·1	59·8	190	13·32	1·00	12 53	89·83	817	29·5	3·69
2	17	88	80·3	0·6	1·9	2·5	3·0	77·5	284	15·89	0 82	15·07	124·73	758	27·4	3·42
3	21	95	86·2	1·2	3·0	4·2	4·7	82·0	372	16·71	1·09	15·62	159·45	741	26·8	3·35
4	24	85	76·7	0·3	1·6	2·5	3·1	74·2	384	15·30	0 82	14·48	168·95	760	27 5	3·44
5	27	80	70·6	1·5	2·2	3·7	5·3	66·9	389	13·80	0·91	12·98	170·37	757	27·4	3·42
6	31	90	79·6	1·7	3·7	5·4	6·7	74·2	497	15·62	1·13	14·49	218·35	759	27·4	3·42
7	31	80	73·2	2·9	2·2	5·1	6·9	68·1	456	14·76	1·00	13·76	207·35	786	28·4	3·55
8	49	60	51·4	3·6	4·4	8·0	15·5	45·4	459	10·73	1·34	9·39	223·60	842	30·4	3 80
9	54	89	80·4	6·8	6·0	12·8	15·8	67·6	763	15·62	1 56	14·06	369·07	836	30·2	3·77
1st Notch—Means		82.						68·2							28.3	3·54
10	17	88	69·9	0·0	3·8	3·8	5 4	66·1	242	12·19	1·10	11·09	91 65	654	23·7	2·96
11	18	70	55·3	0·8	4·5	5·3	9 4	50·0	194	10·33	1·35	8·98	78·57	700	25·3	3·16
12	21	92	72·3	0 0	4·2	4 2	5 7	68·1	309	12·50	1·16	11·34	115·78	647	23·4	2·92
13	26	72	57·1	0·0	4 9	4·9	8 5	52·2	293	10·55	1·41	9 14	115·52	681	24·6	3 07
14	31	79	60·3	1·2	6·0	7·2	11·9	53·1	356	10·87	1·48	9 39	141·50	687	24·8	3·10
15	32	86	64·4	0 8	4·9	5·7	8·4	58·7	407	11·33	1·29	10·04	156,20	663	24·0	3·00
16	40	76	55·7	0·4	4·7	5·1	9·1	50·6	437	9·78	1 35	8·43	163 87	648	23·4	2·92
17	51	70	49·1	2 0	6·2	8·2	16·6	40·9	450	8·65	1·54	7·11	176·30	677	24·5	3 06
18	55	84	62·0	3·6	7·6	11·2	18·0	50·8	603	10·54	1·66	8·88	237·42	680	24·6	3·07
3rd Notch—Means		80						74·5							24·3	3·03
19	17	89	53·2	0·0	9·6	9·6	18·0	43·5	159	7·99	1·85	6 05	50 00	543	19 6	2 45
20	18	70	42·1	0·5	6·6	7·1	16·7	35·0	136	6·59	1·76	4·83	42·16	537	19·4	2·42
21	21	93	56·5	0 0	6·3	6·3	11·1	50·2	228	8·20	1·42	6·78	69 51	525	18·9	2 36
22	28	74	41·8	0 4	6·2	6·6	15·7	35·2	213	6·87	1·68	5·19	70·64	537	19 7	2·49
23	31	83	46 5	0·0	7 4	7 4	15·5	39·1	262	7·29	1·59	5 70	85·89	566	20 5	2 56
24	36	80	39·0	0·0	8·5	8·5	21·1	30·5	237	6·08	1·85	4 23	74 02	540	19 5	2·44
25	50	77	34·7	0·5	8·0	8·5	24·4	26·2	263	5·52	1 76	3·76	91 39	600	21 7	2 71
26	66	90	40·9	0·0	11·5	11·5	28·1	29·4	353	6 24	2·10	4 14	113 20	854	20 1	2 51
5th Notch—Means.		82						30·1							20 1	2·51
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

worked; and the means of the several quantities for the notches separately are as follows:

Consumption per Horse Power per Hour.

For the 1st notch, 28·3 lbs. water, or 3·54 lbs. coke.
" 3d " 24·3 " " or 3·03 " "
" 5th " 20·1 " " or 2·51 " "

As the results under each notch vary very little, the means above stated may be adopted for all practical speeds without material error. From these mean quantities the following rule is derived:

Rule I.—*To find the consumption of Water as Steam per horse power per hour, for a given period of admission.* Multiply the part of the stroke in inches during which the steam is admitted by 22, and divide by the length of stroke in inches, and add 14 to the quotient. The sum is the required consumption in pounds. Let L = length of stroke, S = the period of admission of steam, and W = the consumption of water in pounds per horse power per hour; then

$$W = 22\frac{S}{L} + 14 \quad . \quad . \quad . \quad . \quad (1.)$$

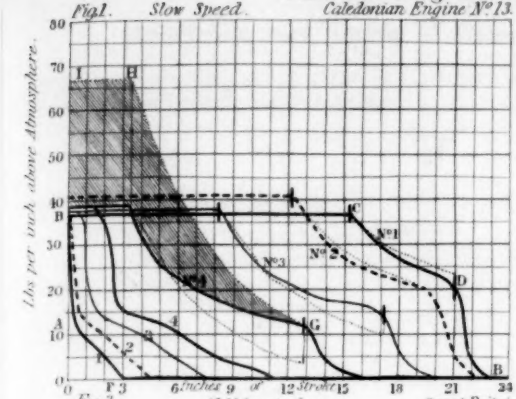
Allowing 8 lbs. of water to be evaporated by 1 lb. of coke, we have the following rule for the consumption of coke:

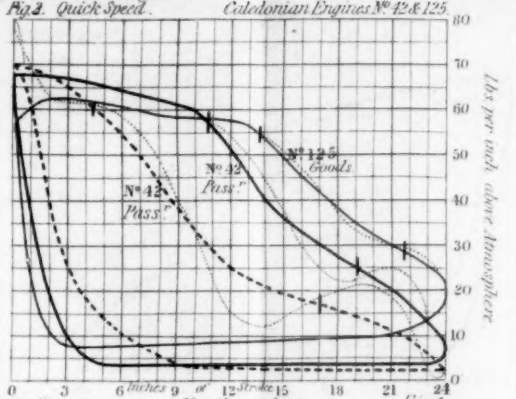
Rule II.—*To find the consumption of Coke per horse power per hour, for a given period of admission.* Multiply the period of admission in inches by 2·75, and divide by the length of stroke in inches, and add 1·75 to the quotient. The sum is the consumption in pounds per horse power per hour. Making C the consumption of coke, we have

$$C = 2{\cdot}75\frac{S}{L} + 1{\cdot}75 \quad . \quad . \quad (2.)$$

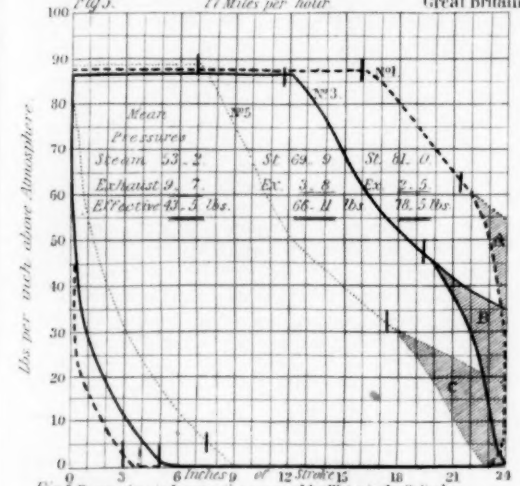
These rules may be employed with safety for all periods of admission between 10 and 75 per cent. of the stroke, which are the utmost limits worth regarding in the locomotive engine. They are applicable also for maximum pressures during admission, ranging between 60 lbs. and 120 lbs., though based on results from steam of 80 lbs. to 84 lbs. maximum pressure. For extreme pressures, the results by the rule are slightly too small in the case of lower pressures, and rather greater for the higher; these divergences being due to the constant deduction of 15 lbs. for atmospheric resistance from the total pressure. It is presumed that engineers will not return to the error of low pressures in locomotives, and that high pressures will be cultivated. For pressures above 80 lbs., the rules are perfectly safe, as they err rather by excess on the safe side. The following table is worked out by Rule I., to show the efficiency of steam by expansion in the locomotive cylinder, under good conditions in actual practice. The 4th column contains the theoretical maximum relative efficiency of steam, expanding to the end of the stroke, according to the law of Boyle, with a perfect vacuum behind the piston, and without clearance, back pressure, or compression; extracted from the ordinary tables on the

Indicator Diagrams from Locomotive Engines.





Great Britain Locomotive.



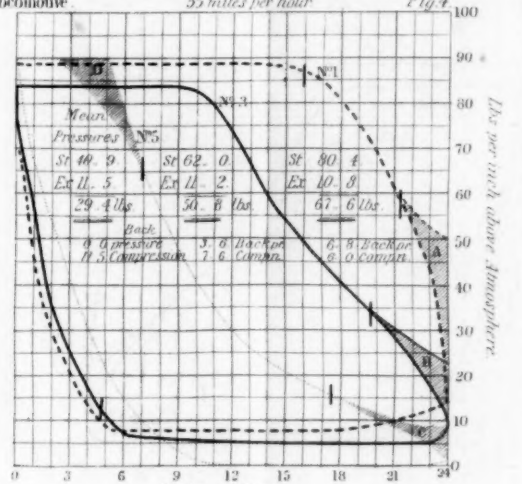
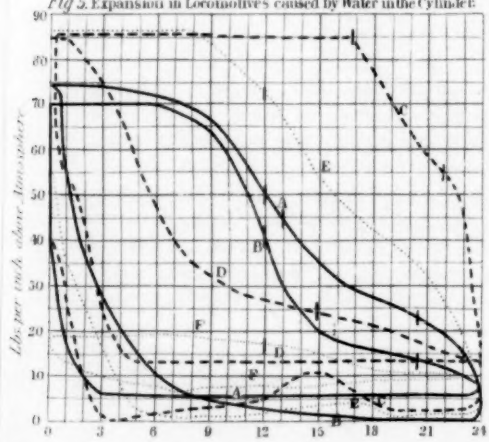


Fig 5. Expansion in Locomotives caused by Water in the Cylinder.

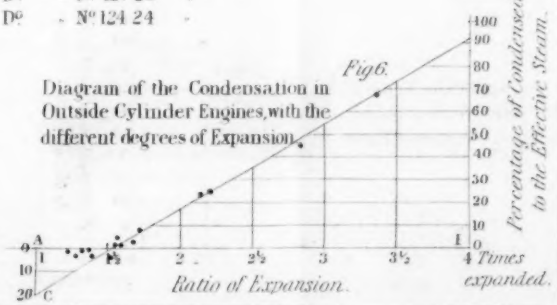


A & B Orion Pass.r Engine 39 Miles per hour.
C & D Nº 127 Goods Eng. 18 " "
E & F Dº Dº 15 " "

Stroke of Nº 13. 20 Inches
Dº " Nº 42. 20 "
Dº " Nº 124 24 "

Fig 6.

Diagram of the Condensation in Outside Cylinder Engines, with the different degrees of Expansion.



subject. In column 5 are given the relative amounts of work done by steam, under the admissions named in column 1, being directly as the effective mean pressures in the cylinder, which are found by a rule to be afterwards given.

Efficiency of Steam by Expansion in the Cylinder of the Locomotive in Actual Practice.

For Maximum Pressures during admission of 60 lbs. to 120 lbs.

Periods of admission or points at which the steam is cut off in parts of stroke.	Water as steam consumed in pounds per horse power per hour.	Relative efficiency of steam in actual practice.	Possible maximum efficiency.	Relative work done by steam of the same maximum pressure in the cylinder.
per cent.	lb.			
10	16·2	2·22	3·30	15
12·5	16·7	2·15	3·08	20
15	17·3	2·08	2·90	24
17·5	17·8	2·02	2·73	28
20	18·4	1·96	2·60	32
25	19·5	1·85	2·39	40
30	20·6	1·75	2·20	46
35	21·7	1·66	2·05	52
40	22·8	1·58	1·92	57
45	23·9	1·50	1·80	62
50	25·0	1·44	1·69	67
55	26·1	1·38	1·60	72
60	27·2	1·32	1·51	77
65	28·3	1·27	1·43	81
70	29·4	1·23	1·35	85
75	30·5	1·18	1·28	89
100	36·0	1·00	1·00	100

The periods of admission of steam to the cylinder may be varied by link-motion from 75, the greatest useful period, to 10 per cent. of the stroke. By the table, the relative efficiency varies within these limits from 1·18 to 2·22, the variation being as 1 to 2 nearly. It follows, that under the most favorable existing circumstances, *the utmost possible efficiency of steam worked expansively* in the locomotive by the link-motion, is *about twice* that of the steam when worked *under full gear;* that is, the *same quantity of steam does twice the quantity of work.*

By a consideration of the effective mean pressures in the first table, it appears that the average rate at which it increases with the period of admission is expressed by the following rule:

Rule III.—*To find the effective Mean Pressure in the Cylinder, in terms of the Maximum Pressure, for a given per centage of admission.* Multiply the square root of the per centage of admission by 13·5, and subtract 28 from the product. The remainder is the effective mean pressure in per cent. of the maximum pressure of steam admitted. By this rule the following table is composed:

Effective Mean Pressure in the Cylinder for Various Admissions.

For Maximum Pressures of 60 lbs. to 150 lbs.

Periods of admission in parts of the stroke.	Effective mean pressures in parts of maximum pressure.	Periods of admission in common fractions of stroke.	Effective mean pressure in common fractions of the maximum pressure.
per cent.	per cent.		
10	15	1-10th.	1-7th full.
12·5	20	....	....
15	24	1-8th.	1-5th.
17·5	28	....	....
20	32	1-6th.	1-4th.
25	40	1-5th.	1-3d.
30	46	1-4th.	1-25th.
35	52	1-3d.	1-2d.
40	57	....	....
45	62	....	....
50	67	1-2d.	2-3ds.
55	72	....	....
60	77	....	....
65	81	2-3ds.	4-5ths.
70	85	....	....
75	89	3-4ths.	9-10ths.

In all well protected cylinders, with blast orifices not less than $\frac{1}{18}$th of the area of the cylinder, the foregoing rules and tables of data apply to the action of steam at speeds under 30 to 40 miles an hour, as the writer has fully shown in his work on *Railway Machinery*. For speeds amounting to 55 to 60 miles an hour, the loss by imperfect exhaust causes a large increase of consumption per horse power per hour, of from 33 to 12 per cent., according to the amount of admission. With steam ports of about $\frac{1}{14}$th, and blast orifices $\frac{1}{14}$th of the cylinder, the rules likewise apply, at speeds under 30 to 40 miles an hour. At the higher speeds, the useful power is considerably impaired by imperfect exhaust.

The proportions of the *Great Britain*, from the performance of which the foregoing results are deduced, may be repeated here as standard ratios for practice, until superior results are obtained.

Sectional area of cylinder, ...	1
" " steam port, ...	1-10th
" " blast orifice, ...	1-11th

Lap of valve, $1\frac{1}{4}$ in.; travel, $4\frac{1}{2}$ in. in full gear; lead, $\frac{1}{4}$ to $\frac{3}{8}$ in.

In a second paper, the writer discusses the *conditions* necessary for the successful expansive working of steam in locomotives. The following is a comparison of the actual results of engines working with ordinary *gab-motions* and with *link-motions*. The engine *Europe*, on the Edinburgh and Glasgow Railway, cylinder 16×18 inches, wheel 6 feet, doing one week's work in 1849, with *gab-motion*, consumed an average of 19 cwt. of coke per day, and 2 cwt. of coal. As, in the locomotive boiler, coal is about two-thirds of the value of coke, 2 cwt. of coal is equivalent to 1·33 cwt. of coke; and the consumption per day may be stated at 20·33 cwt. coke.

The same engine, fitted with *link-motion*, used at the same season in 1851, and doing the same work, 12 cwt. of coke, and 3 cwt. of coal daily, equivalent to 14 cwt. coke. Over a run of 94 miles, the expenditure becomes

24·22 lbs. per mile with gab-motion.
16·70 " " link-motion.

7·50 " reduction, or 30 per cent. with link.

The periods of admission in the two cases would be about 70 and 45 per cent., and by the table of efficiency the consumption would be as 1·50 to 1·23, showing an economy of only 18 per cent., or barely two-thirds of what was actually made. The greater actual efficiency must in great part be due to the superior opportunity of working with high pressure, during the admissions offered by the link.

Again, the test may be applied by measuring the water consumed. The following are a selection of cases from the writer's own experience and observation:

Engine with Link-motion; cylinder, 15×20 inches; wheel, 6 feet. Edinburgh and Glasgow Railway.

Date.	Engine.	Mean speed. Miles per hour.	Average train of Carriages.	Consumption of water in feet, per mile.	Remarks.
1851	"Orion," ordi-				
August 26.	nary train.	19·6	16	2·97	Stiff wind ahead.
" 26.	Do. do.	24·4	7	2·01	Do. favorable.
August 27.	Do. do.	24·4	7	2·22	Do. ahead.
" 27.	Do. Express.	32·0	5	1·65	Do. favorable.
1850.					
Sept. 7.	Do. do.	32·7	5	1·65	Slight wind ahead.

Engines with fixed Gab-motion, cylinder 16 × 18 inches, wheel 6 feet. Edinburgh and Glasgow Railway.

1850.					
Sept. 3.	"America," ordinary.	21·5	13	3·01	Wind favorable.
October 10.	"Nile," Expr.	29·0	7½	3·00	Do. ahead
" 21.	"Niger,"	....	7	2·80	Calm.

Express engine, with fixed Gab-motion; cylinder, 16 × 18 inches; wheel, 6 feet. North British Railway.

1851.	Express.	38·5	5	2·70	Calm.
	"	38·5	5	2·70	Do.
	"	38·5	4	2·96	Wind ahead.
	Mail.	35·7	7	3·05	Calm.
	Ordinary.	22·0	12	3·45	Calm.

These results show, as before, that under similar circumstances, what has been deduced from an independent examination of indicator diagrams, taken under the link-motion, as to the *economy* of steam *worked expansively*, is fully borne out by a direct appeal to the relative consumption of coke and water.

(To be continued.)

For the Journal of the Franklin Institute.

Description of Lahaye's Patent Self-Acting Brake.

EXPLANATION OF THE FIGURES.

a Timbers of car body.
b " of trucks.
c Bumper of pulling bar.
d Pulling bar coupled to engine or train.
e Shaft communicating power of pulling bar, *d*, when train is checked to brake blocks.
f Fixed pivot of shaft, *e*.
g Pulling rods, acting upon brake blocks from shaft, *e*.
h Springs acting upon all brake blocks by *g* and *i*.
i Tie rods connecting brake blocks.
k Hangers suspending brake sockets from truck.
l Brake blocks, movable in their sockets.
m Sockets, channeled to receive brake blocks.
n Lifting bars, moving with "
o Bell crank levers, moving detaching rods *q*.
p " " " "
q Detaching rods, acting upon cranks, *r*.
r Cranks, moving detaching shaft.
s Tongue, on detaching shaft, moving pulling bar, *d*, out of gear.
t Rollers, between brake block and sockets.
u Slots, for motion of rollers.
r Pulling bar spring.

Operation of Brake, Fig. 1.—The car is supposed to be coupled to an engine, by the pulling bar *d* at *c*. Immediately on the steam being shut off, the momentum of the car and train behind it presses the pulling bar upon the engine at *c*; this pressure is communicated by a shoulder in *d*, through the shaft *e*, pulling rods *g*, springs *h*, and tie rods *i*, to all the brake blocks, causing them to act upon all the wheels with a force proportioned to the resistance at *c*, and ceasing only with the latter resistance.

Operation of Detaching Levers, Fig. 2.—The brake blocks are supposed to be pressed against the wheels, the engine reversed, the train stopped, and required to be backed. The wheel B, fig. 2, turning in the direction of the arrow, moves the brake block, *l*, upwards in the same direction, carrying with it the lifting bars, *n*, acting upon the bell cranks, *o p*, detaching rods, *q*, and crank, *r*, thus moving the tongue, *s*, upwards, and ungearing the pushing bar, *d*, allowing the car to be moved backwards by the bar, *d*, pressing against the ring bolt by a slot in *d*, through which said ring bolt passes.

General Remarks.—The detaching motion is instantaneous in its action. The ordinary hand brake can be applied to every car with the self-acting brake, and acts independently of the latter. When it is not required to back the train, the pressure of the brake blocks is relieved immediately by the forward motion of the pulling bar, *d*.

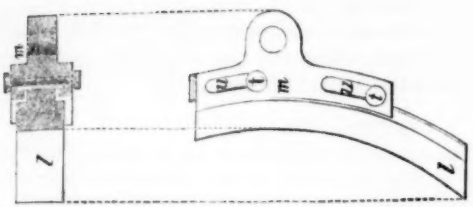
The chief advantages of this brake are as follows:

1st, It is self-acting, operating only when it is desired to stop the train or diminish its speed, and relieving the wheels of its pressure instantly, on the cars feeling the forward or backward motion of the engine.

2d, Its action is instantaneous on every car in the train, commencing the moment the steam is shut off the engine, and ceasing only with the motion of the cars.

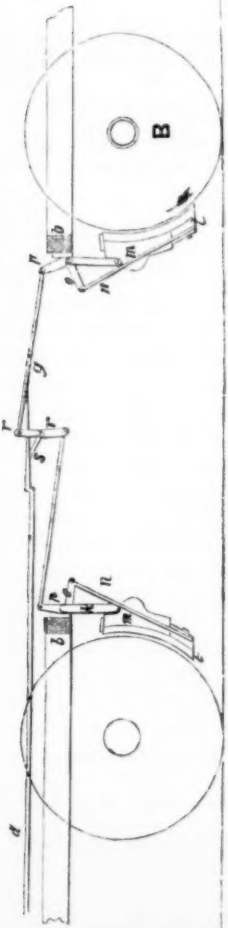
3d, Its power is exactly proportioned to the necessity for the gradual or sudden stoppage of the train, resulting from the judgment of the engineer in the management of his engine; the brakes acting with moderate force when the steam is shut off the engine, with increased intensity if

Fig. 3.



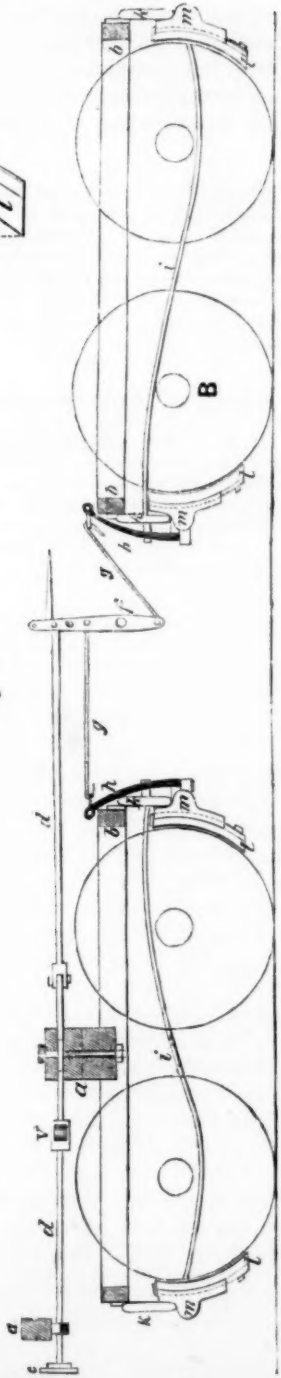
Brake Blocks.

Fig. 2.



Detaching Levers.

Fig. 1.



Braking Apparatus.

the tender brake be applied, and with sufficient force to back the wheels (if required) if the engine be reversed.

4th, It is simple in its construction and operation, not liable to derangement, and so constructed as to allow the use of the ordinary hand brake on every car, when the latter is moved separately.

CERTIFICATES.

Lahaye's Patent Brake has been in operation upon the passenger trains of the Philadelphia and Reading Railroad for several months past. It has worked to our satisfaction, has caused no expense for repairs, remaining in the same condition as when first put on, and proving on many occasions eminently useful in arresting the rapid motion of the train, when danger was observed and the engine reversed.

I consider it one of the most valuable inventions ever made to increase the safety of railroad traveling, as by its use a passenger train can be stopped in about half the space usually required.

G. A. NICOLLS,
Eng. & Sup. Philad. & Reading Railroad.

Reading, Pa., March 16th, 1852.

Mr. John Lahaye's Self-Acting Brake has been in operation on the passenger cars of the Philadelphia and Reading Railroad for several months, and its operation has been such as to give entire satisfaction. I think a fair trial of it by any railroad company will convince them that it is the only contrivance of the brake kind that can be relied on when there is a necessity for stopping a train in case of collisions.

I would recommend it particularly to railroads using but a single track; for them I think it indispensable.

JAMES MULHOLLAND,
Master Machinist, Philad. & Reading Railroad.

Reading, Pa., March 16th, 1852.

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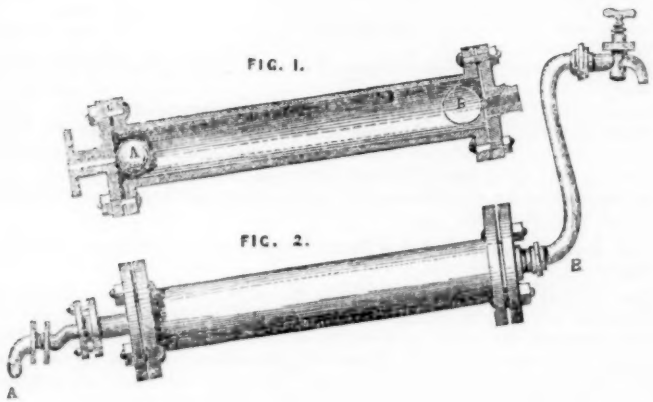
*Description of Pilbrow's Water Waste Preventer.**

This article, manufactured by Guest & Chrimes, of Rotherham, is introduced for the purpose of detecting and preventing waste of water supplied to the inhabitants of towns by water works, whether such waste be wilful (as is too often the case amongst the inconsiderate occupiers of cottage property), negligent, or accidental from leakage or bursting of pipes, leaving open taps, &c., and is especially applicable, and may be said to be almost indispensable, where water is supplied on the "high-pressure" and "constant-supply" system. When it is considered that under this system, at a pressure of, say 150 feet, the smallest tap in ordinary use—viz. ¾-inch—will, if left open for only one night of ten hours, waste from four to five thousand gallons of water, it will be most manifest that any article which will prevent a waste of such serious magnitude is one that must fairly claim immediate attention, and insure extensive adoption.

The Water Waste Preventer is calculated and guaranteed not only to remove this difficulty, but also to obviate the necessity of stop-cocks, as these will be no longer required for the purpose of shutting off water whilst repairs are being made to taps and pipes in consequence of leakage, the removal, or repairs of broken taps or service pipes, bursting of pipes from frost, or any other ordinary cause.

* From the London Civil Engineer and Architect's Journal, May, 1852.

Fig. 1 shows "the Preventer" in section with the ball in two positions, one as when the supply of water has been drawn, and the ball thereby brought to the top of the tube, closing the service aperture, as at B; the other when all is shut off, as at A. Fig. 2 shows "the Preventer" with



ferrule for connecting to the main pipe, as at A, and to the service supply pipe, as at B. It consists of a tube of cast iron, or other material, having flanches at each end, one to attach to the main supply pipe, the other to the service supply pipe; a ball of peculiar material and gravity is inserted in the tube. The tube when attached to the main supply pipe, is laid at an elevation varying according to the pressure at which the water is supplied, the service end being the highest; if there is no leakage or draw upon the pipes, the ball will be, and remain at the bottom of the tube, as shown at A; but when water is required to be drawn, and the tap is opened for that purpose, or should the pipe be burst, or water running to waste from any cause, the ball immediately and gradually ascends until the quantity of water the machine is intended to deliver has taken place, when the ball will have moved to the top of the tube (as at B), and closed the aperture of the service supply pipe, and the delivery will have ceased until the tap be closed, or the defects remedied, when the ball will return again to the bottom of the tube, and further deliveries in succession may be obtained. From this it will be seen that waste of water from the taps being left open for a longer time than while the required and limited delivery is taking place, IS IMPOSSIBLE. After such delivery has taken place, and whilst the tap continues open, the ball will remain at the top of the tube, closing the service pipe aperture, so as that the merest driblet can escape. And this will be the case under all the circumstances from which undue waste of water arises—whether from wanton mischief done to the pipes or taps—from bursting or other leakage of pipes—from taps in houses, yards, or water-closets being left open, or any other cause, wilful or accidental.

AMERICAN PATENTS.

List of American Patents which issued from Nov. 9th to Dec. 7th, 1852, (inclusive,) with Exemplifications by CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

NOVEMBER 9TH.

20. For an *Improvement in Oil Presses;* William P. Chadwick, Edgarton, Massachusetts.

Claim.—"What I claim as my invention is, the arrangement of the screw within the body or interior of the box, in combination with so applying it to one head of the box, and to the platen, that by its revolution in one direction, the platen will be drawn towards the said end of the box, all substantially in manner and for the purpose as above specified, not meaning to claim the combination of a screw, platen, and box, but intending to limit my claim as above described."

21. For an *Improvement in Printing Presses;* Joel Densmore, Blooming Valley, Pennsylvania.

Claim.—"What I claim as my invention is, the combination, substantially as described, of the fingers or grippers, for seizing the sheets and holding them to the cylinder, and the fingers for throwing the sheets off from the cylinder, said fingers or grippers being attached to shafts arranged longitudinally to the cylinder, and attached thereto, and being turned to give the necessary movements to the fingers by the revolution or vibration of the cylinder through the agency of cranks and rods, or their equivalents."

22. For an *Improvement in Marine Signals;* Thomas H. Dodge, Nashua, New Hampshire.

Claim.—"What I claim is, placing the lamp on a movable pedestal, or its equivalent, inside the many-sided signal-box, and raising or lowering the same from one colored glass to another, by means of a cord and pulley, or their equivalents, the whole being constructed, arranged, and operating in connexion with a signal, in the manner and for the purposes substantially as herein described."

23. For an *Improvement in Turning Jaw Vises;* Abijah Halbert, Augusta, Georgia.

Claim.—"I am aware that the revolving jaw of a vise has been set, and then secured to any desired angle with the fixed jaw, and I do not claim so doing; but what I do claim as my invention is, constructing the jaw of a revolving vise, with a flanch or projection provided on the edge thereof with a female screw, in which mesh the screw, or other equivalent, operating on said jaw, in the manner and for the purposes set forth and shown, by which I am enabled to both set and secure the revolving jaw at the same time."

24. For an *Improvement in Saddles;* Thomas Mardock, Cincinnati, Ohio.

Claim.—" What I claim is, the construction of a saddle with seat attached to the pommel and cantle, by lips, as described, or in any equivalent manner, so as to be easily removable for the inspection, and, if need be, alteration of any part of the saddle."

25. For an *Improvement in Mode of Throwing Shuttles in Looms;* Stephen C. Mendenhall, Richmond, Indiana.

"My invention relates to improvements in looms for weaving two cloths united at the selvedges; that is, for weaving a continuous cloth, the weft, instead of being passed back and forth by the shuttle, passes completely round, or forms a continuous circuit without a selvedge."

Claim.—"Having thus fully described the construction and operation of my 'Columbia Bagging Loom,' what I claim is, the combination and arrangement of the spring triggers, cords, and treadles, so that the depression of any one of these treadles shall release the triggers on the forward movement of the lay, and allow the picker staff to actuate the shuttle, substantially as set forth."

26. For an *Improvement in Hand Looms;* Stephen C. Mendenhall, Richmond, Indiana, and Obed King and Ezra King, Salem, Iowa.

"Our invention consists, first, in effecting a movement of any number of heddles, and varying the number of the same by a motion derived from the lay, so as to produce fabrics

of two or more looms with the same loom, without the use of cams, and without removing any part of the machinery; and, second, in effecting a throwing of the shuttle by an inclined plane action, which operates independently of that for shedding the web."

Claim.—"Having thus fully described our invention, what we do claim is, the combination of the nerve, operated by lay, inclined plane, and its guides, and adjustable pin, or their equivalents, combined and operating as described, so that we can operate and vary the number of heddles, substantially as and for the purpose set forth.

"We are aware that the picker staff has been operated by hooks, alternately raised from the shoulders on the picker staff by pins on a vibrating slide, operated by grooves in the treadle cam; this we do not claim: but we do claim the combination of the inclined plane, on picker staff spring, and hooks, for the purpose of sliding the hooks, in the manner and for the purpose specified."

27. For *Improvements in Steering Sub-Marine Vessels;* L. D. Phillips, Michigan City, Indiana.

Claim.—"What I claim as my invention is, the arrangement of the shaft of the propeller, so as to pass through and be guided by the tiller, or the equivalent thereof, mounted on an universal joint, in order that a propeller may be driven by one hand, while the vessel is steered in any direction by the other, substantially as herein set forth.

"I likewise claim the combination of an universal rudder, with a series of keels arranged on the top, bottom, and sides of the vessel, to aid in steadying her, and to facilitate the steering of her in various directions, by means of an universal rudder, substantially as herein set forth."

28. For an *Improvement in Horse-Shoe Machinery;* Solomon Shetter, Alleghany, Pennsylvania.

"My improvement consists in the arrangement of certain levers, revolving dies, and cams, in the manner hereinafter described, for turning and forming a horse-shoe."

Claim.—"Having thus fully described my improvement, what I claim therein as new is, the arrangement of shifting dies and adjustable levers and cams, substantially in the manner and for the purpose set forth."

29. For an *Improvement in Twisting Tubes in the formation of Roving;* Harvey Silver, Lowell, Massachusetts.

Claim.—"Having fully described my invention and its adaptation, what I claim as new is, 1st, The construction and use of tubes for giving countertwist to roving, by having a slot in the side, in such a manner that the roving can be laid into the tube without the use of a hook, as described.

"2d, The construction, arrangement, and use of tubes, for giving countertwist to roving in such a manner, that without disengaging the driving apparatus, the tube can be so turned on its support, that a hook can be passed between the bosses of the rolls through the revolving tube, to draw the roving into the tube, without stopping the parts, as described.

"3d, The construction and use of tubes for giving countertwist to roving, by making them in two parts, into one of which the roving can be adjusted and then dropped into the other, giving it the necessary rotary motion to form the twist."

30. For *Improvements in Machinery for Crimping Metal Bars;* Giles Slocum and M. T. Sayles, Lansingburgh, New York.

"The invention consists in a peculiar manner of operating a pair of dies, one or both of which may be flexible, said dies passing between pressure rollers, which force the dies together and crimp or bend the iron, as will be fully described hereafter."

Claim.—"We do not claim the flexible die, nor the combination of the permanent die and flexible die, as they have been previously used; but what we do claim as our invention is, the peculiar manner of operating said dies, as herein shown and described, viz:—by means of the pressure rollers and the lower rollers being fixed permanently in the frame, and the upper rollers arranged so as to yield to the die, when necessary; the movable bed being attached by a cord or chain to the roller, by turning which, the bed is drawn between the upper rollers and the lower rollers, the upper rollers forcing or compressing the flexible die upon the permanent die, and bending or crimping the bar, as set forth."

31. For an *Improvement in a Cooking Range;* George S. G. Spence, Boston, Massachusetts.

Claim.—"What I claim as my invention is, my improved combination of a heat radiating chamber applied to the rear end, and two draft flues applied to each of the four faces, at top, bottom, and two sides of an elevated oven of a cooking range; that is to say, I claim the combination of the heat radiating chamber (against the end of the oven), two draft flues (against the bottom of the oven), two flues (against one side of the oven), two draft flues (against the other side of the oven), and two draft flues (against the top of the oven), all connected and made to operate together, substantially as specified; my said combination of flues, as they are above arranged, causing the smoke and other volatile products of combustion, to pass from the back of the flue space under the boiling chamber, into a flue leading under the rear part of the oven, and transversely across, or from side to side of the oven, thence up a flue leading against the side of the oven, thence down a flue leading against such side of the oven, thence into a reservoir flue leading transversely across and under and against the bottom of the oven, thence upwards into and through a flue leading horizontally and along the other side of the oven, and from front to rear of it; thence into and through a flue leading horizontally against such second or other side of the oven, thence into a flue leading across the top of the oven and from side to side of it, thence into and through another flue leading over and against the said top, and in an opposite direction to the last mentioned, and thence into the chimney or discharge flue."

32. For an *Improvement in Brick Machines;* Henry H. Strawbridge, New Orleans, and Daniel Tyson, Covington, Louisiana.

Claim.—"What we claim as our invention is, the roller in combination with a reciprocating series of moulds, for the purpose of gauging the quantity of clay to be compressed into the said moulds, the several parts being arranged and operating as herein described.

"We also claim the method herein described of finishing the surface of dry clay bricks in moulds, by first shaving off the surplus material, and then smoothing the shaved surface by rubbing it under heavy pressure while confined in the mould, to prevent it from breaking under the operation, as it would do if not so confined."

33. For an *Improvement in Automatic Fans;* Seth E. Winslow, Kensington, Pennsylvania.

Claim.—"What I claim is not mounting a fan upon a rocking chair, and operating it from the motion of the chair, as that has been done before; but what I do claim as my invention is, the mode of operating the fan by means of the rod impinging upon the floor, and made to re-act by means of a spring, substantially as herein set forth."

34. For an *Improvement in Gas Burners;* A. H. Wood, Boston, Massachusetts.

Claim.—"Having described my improvement in gas burners, what I claim as my invention is, the use in a gas burner of a distributor, constructed substantially as above described, for the purpose of producing a steady jet or flame, and for preventing the blowing and waste of gas in the burner."

35. For an *Improvement in Reciprocating Die-Spike Machinery;* Moody Belknap, Assignor to Moody Belknap and Lyman Kinsley, Canton, Massachusetts.

Claim.—"I do not claim a series of two or more griping or holding dies made to rotate around one common axis or shaft; nor do I claim reciprocating dies, each provided with its own griping die: but what I do claim as my invention is, the combining the two reciprocating bed dies (affixed to a carriage having a horizontal movement as stated), with the griping lever as the upper die for both, so as to operate therewith, substantially in the manner as above described."

NOVEMBER 16TH.

36. For an *Improvement in Expanding Bits;* Charles L. Barnes, City of New York.

Claim.—"Having fully described my invention, what I claim therein as new is, so forming and combining the movable and stationary parts of an expansion bit for boring different sized holes, as that a cutting edge shall, at all times, be preserved entirely across the bit, and at the same time the cutting point on the movable part thereof shall always be parallel with the shank of the bit or the line of the hole, substantially as herein described.

"I also claim the rising and falling of the movable part of the bit, as it is contracted

and expanded, by means of the inclined slots and set screws, or their equivalents, so that the lip on the movable part shall become the cutter when boring the largest sized holes (the other lip being at rest), and the lip on the stationary part shall become the cutter when boring small-sized holes, the other lip being at rest, by which means I am able to form the lips of the proper shape for different sized holes without changing the cutters, substantially as described."

37. For an *Improvement in Seed Planters;* Levis H. Davis, Samuel and Morton Pennock, Kennett Square, Pennsylvania.

Claim.—"Having described our improvements in seeding machines, what we claim as our invention is, 1st, The employment of the sigmoid, or other similarly curved or angular receiving and discharging openings, in combination with the reciprocating slide and feeding stubs, for the purposes specified, the said reciprocating slide having angular points projecting into the aforesaid sigmoid openings, for effecting the discharge of the seed from the outlets from which the stubs are receding, while the latter are feeding the seed towards the opposite extremities or outlets of the openings during each movement of the slide, by means of the inclined sides of said points, and the movement of the slide."

38. For an *Improvement in Flax Pullers;* Lewis S. Chichester, Brooklyn, New York.

Claim.—"I do not wish to limit myself to the mere matters of construction or arrangement of the parts, as these may be greatly varied within the principle of my invention, by the substitution of mere mechanical equivalents. What I claim as my invention, for the purpose of pulling and gathering flax, is the employment of one or more pairs of rollers, substantially as described, in combination with the fingers or separators, or their equivalents, for presenting the stalks to the bite of the rollers, to be drawn in, substantially as described.

"I also claim, in combination with the rollers for drawing in the flax, as specified, the employment of the revolving arm or arms for collecting and drawing the stalks to the bite of the rollers, as described.

"And, finally, I claim, in combination with the rollers for drawing in the stalks, as described, the employment of the fulcrum bar, substantially as described."

39. For an *Improvement in Carpet Looms;* John A. Van Riper, City of New York.

"My invention and improvements consist in the arrangement of mechanism, by means of which a single cam and side bar, with suitable pawls, is made to actuate a positive let-off of yarn, a positive take-up of the woven cloth, and a variable conditional winding up of the woven cloth upon the cloth-beam. My invention further consists in a method of working the trap-boards, which is at once simple and certain, and which is carried into effect by cheap and durable mechanism."

Claim.—"Having thus described my improved loom for weaving carpets and other fabrics, by power, what I claim therein as new is, 1st, Actuating a positive let-off for the delivery of yarn, a positive take-up of the woven cloth, and a variable winding upon a beam of the cloth, delivered from the take-up rollers, by the combination of the crank pin or cam on the disk, or the equivalent thereof, with the alternating bar and its appendages, substantially as herein set forth.

"2d, The method herein described of working the trap-boards, with suitable intervals of rest and motion, by means of the crank cam, the rock-shaft and its arms, the lifting-rods, the cam, and lever, and the other devices acting in connexion with these, for raising, and lowering, and oscillating the lifting-rods, the whole operating substantially as herein described.

"3d, I claim the temples constructed, arranged, and operated, substantially as herein described, so that they will be open during the time the take-up rollers are acting, and closed at the time the lay beats up."

40. For an *Improved Machine for Making Thimbles for Rigging, &c.*, William Field, Providence, Rhode Island.

Claim.—"Having described my improved machine for making thimbles, &c., what I claim therein as new is, arranging the two halves of the forming groove, upon the adjacent ends of two independent revolving mandrels or shafts, which are free to slide towards and from each other, so as to hold the two halves of the groove in contact, while the article is being shaped, and to separate the two halves of the groove, to allow the finished article to drop out.

"I also claim the combination of the divided shaping groove, with a reciprocating former operating in connexion therewith, substantially as herein set forth."

41. For an *Improvement in Cotton Seed Planters;* William A. Gates, Mount Comfort, Tennessee.

Claim.—"Having described my machine for planting cotton seed, what I claim as my invention is, in combination with a rotating cylinder or box, having apertures in its perimeter, the projecting edges or wings, radial ribs or plates, and projecting fingers or prongs arranged around the axle, the whole operating to separate or disentangle the seeds to be sown, immediately previous to the disposition thereof in the furrow, as set forth."

42. For an *Improved Sash Stopper and Fastener;* J. B. S. Hadaway, East Weymouth, Massachusetts.

"The nature of my invention consists in constructing a sash fastener, by the combination of a rocking plate, spiral spring, and levers; the plate and spring being acted upon in such a manner by the levers, that the sash can be securely fastened, or maintained in any position by the fastener."

Claim.—"What I claim as my invention is, 1st, The combination of the rocking plate with the angular lever, the swinging lever, and the spiral spring, constructed and arranged, and operating in the manner and for the purposes herein specified.

"2d, The rocking plate combined with either a simple or compound lever, in the manner and for the purpose herein specified."

43. For an *Improved Blind and Shutter Operator;* Robert V. Jones, Birmingham, Pennsylvania.

Claim.—"What I claim as my invention is, the tubular shanked box hinge, with roller contained therein, as arranged with respect to the roller within the building, when the rollers are connected by a chain, and the whole is constructed as herein described, constituting a convenient blind or shutter operator."

44. For an *Improvement in Tanning;* David Kennedy, Reading, Pennsylvania.

Claim.—"Having described the manner in which my chemical compound for tanning is compounded and used, what I claim as my invention is, the use of borax in combination with nitre, alum, and terra japonica, in solutions of tannin, substantially as and for the purposes herein set forth. The property of the borax I have found of essential use in raising the hides in the tanning process, and preparing it without injury for speedy and safe tanning."

45. For an *Improvement in Bottle Stoppers;* Edward and D. Kinsey, Cincinnati, Ohio.

Claim.—"Having fully described the manner of constructing our self-acting bottle and can stopper, we will proceed to state what we claim as our own improvement. We claim the combination of the ball stopper, together with the rod attached to it, and the guides, in the manner and for the purposes substantially as herein set forth."

46. For an *Improvement in Cylinder Printing Press;* Joel G. Northrup, Syracuse, New York.

Claim.—"Having fully described the construction and operation of my improved press, what I claim as my invention is, 1st, Such a combination and arrangement of a horizontal bed and cylinder of a printing press, as will enable each forward movement of the bed to impart a revolution to the cylinder, for the purpose of taking or giving an impression, and permit it to remain stationary during the reverse movement of the bed, substantially as herein described.

"2d, I claim, in combination with a horizontal cylinder, moving in one direction, with alternate rest and motion, the inking and flying apparatus, substantially as described."

47. For *Improvements in Perspective Drawing Apparatus;* Professor Adolph Richter, City of New York.

"The nature of my invention consists in a new and useful manner or method of delineating upon common unprepared glass, or other transparent medium, with the aid of a simple and cheap instrument, consisting of a compound or composition of ink, a diminishing glass, chalk, &c., artificial and natural objects, and afterwards transferring the same upon paper, canvas, stone, copper, wood, &c."

Claim.—"Having thus fully described my invention, I would state that I am aware

that natural and other objects have been traced through and upon the surface of glass or other transparent medium, and I do not claim it; neither do I claim any of the parts of my apparatus when taken separately; but what I do claim is, delineating natural and other objects, in a diminished or increased size, with a lens, when used with the apparatus, and in the manner described."

48. For an *Improvement in Printing Presses;* Stephen P. Ruggles, Boston, Massachusetts.

Claim.—"Having fully described my invention, what I claim therein as new is, so hanging or balancing the bed which holds the form, and move up and down for each impression, upon springs, as that its own weight shall compress the springs to a great extent, and the entire compression of them be completed by drawing the bed farther down whilst in motion, and so that the elasticity of the springs, when the bed is to rise, will raise it up to the extent of their power, and the upward motion be completed by a separate arrangement, whilst in motion, for the purpose of relieving the machine from overcoming the inertia, in moving the bed from a state of rest, the power to complete its motion being applied near the termination of its movement, substantially as described.

"I also claim the arranging of the frisket and the inking rollers in separate carriages, moving on the same ways with such relative velocities as not to interfere with each other, and so that the frisket may carry off and bring back the sheet quickly, whilst the inking-rollers may travel more slowly and do more perfect work, substantially as described.

"I also claim the pointing of the sheet whilst being prepared for receiving the first impression, by an automatic movement, attached to some moving portion of the press, and so that the operator may use both his hands in guiding and controlling the sheet.

"I also claim the application of a blast of air, or its equivalent, for the purpose of forcing the sheets upon the registering points when the paper is being prepared for the reverse impression, so that the operator may use both his hands in guiding and controlling the sheet.

"I also claim the removing of the sheet from the frisket, or from the press, by means of atmospheric pressure, applied in the manner herein described, or its equivalent, for the purpose of turning over the sheet in its delivery, substantially as described.

"I also claim making the registering points adjustable in the paper table, by passing it through a friction plate, secured between two plates, and so that it may be moved in any direction, by a slight tap, for the purpose of allowing for the unequal shrinking or drying of the paper, or of any movement of the form, after the first impression is taken, substantially as herein described.

"I also claim the combination of the open toggle and adjustable eccentric shaft or pin which operate the bed, for the purpose of regulating the impression, by increasing or diminishing the distance between the bed and platen, substantially as described."

49. For an *Improvement in Bracing and Supporting Card Teeth;* Cornelius Speer, City of New York.

Claim.—"Having described my improvement, what I claim as my invention is, the application of the material herein described, to the front side of the leather fillet holding the card teeth, for the purpose of bracing and supporting said teeth."

50. For *Improvements in Serving Mallets;* Daniel H. Southworth, City of New York.

Claim.—"What I claim as new in my invention or improvement are, 1st, The attachment and use of the clasp or hook to the hollow or concave part of the saddle of a serving mallet, for the useful purpose of holding it to the rope, while the operator brings the end of the marline from the spool over the pulley in the handle and upper edge of the saddle to the rope, where it is made fast, without being wound round both saddle and rope, as is done in using other mallets, the whole being constructed and arranged substantially in the manner and for the purposes described.

"2d, I claim the attaching to a serving mallet one or more set of thumb-screws, or any analogous device, for the purpose of pressing upon the spool, for the useful purpose of enabling the operator to serve the rope with any degree of tightness the yarn will bear, without winding it round both saddle rope and handle, as is done in using other mallets, the said screws being attached and operating substantially in the manner and for the purposes described."

51. For an *Improvement in Railroad Car Seats;* Daniel H. Wiswell, Buffalo, New York.

Claim.—"Having described my invention and improvement in day and night change-

able seats for railroad cars and other purposes, by which, in a moment, the occupant can convert it into a sitting or reclining chair, whether the cars be going or returning, so that the traveler may repose as comfortably as in a bed, or sit as easy as in a parlor chair, what I claim as my invention is, the employment of double jointed slides and jointed rods, with the jointed arms, jointed seat and back, pillars and supports, arranged and operating substantially in the manner and for the purposes herein fully set forth."

52. For an *Improvement in Cordage Machinery;* Hezekiah T. Jennings and Charles S. Collier, Bethany, and Thomas P. How, Buffalo, Assignors to H. T. Jennings and Charles S. Collier, Bethany, and Dorus Perry and Amenzo Beardsley, Middlebury, and Allen Hemmingway, Perry, New York.

Claim.—"What we claim as our invention is, regulating the speed of the receiving reel by the tension of the rope, substantially as herein described."

NOVEMBER 23D.

53. For an *Improvement in Machines for Drilling Stone;* Jos. J. Couch, Philadelphia, Pennsylvania.

Claim.—"What I claim as my invention is, the improvement of making the drill rod to slide through the piston rod, substantially in manner as above set forth.

"And I also claim the combination of the rocker lever, the wedge, the bolt within the lever, the two cam plates, the spring catch, the spring and the projection as applied to the drill shaft, the carriage or block and the slide-ways thereof, and made to operate together, and to actuate the drill substantially in manner as herein before set forth."

54. For an *Improvement in Swinging Churns;* William F. and Nathan Davis, Castleton, Vermont.

Claim.—"What we claim as our invention is, the combination of the swing slotted board, wheel, rock shaft, and lever, for the purpose of producing two complete motions of the dash from one full oscillation of the pendulum bars, substantially as herein described, to be denominated, 'The Oscillating Double Acting Dash Churn.'"

55. For an *Improvement in Pincers for Operating Pile Wires;* Augustus Faulkner, Walpole, New Hampshire.

"The nature of my invention consists in withdrawing, supporting, carrying, replacing, and releasing the figuring wires, by means of a claw, operated automatically by the moving parts of the loom."

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new is, the manner herein described, of constructing and operating the claw for withdrawing, carrying, replacing, and releasing the figuring wires, viz:—by making one of the jaws fixed, and providing it with a pin or projection, extending into a suitable slot in the sliding part of the claw, so that as said part moves back and forth, in contact with the fixed part of the jaw, the pin or projections therein will, when the figuring wire is to be seized, keep it in position for being properly caught in the claw, and when it is to be released, will prevent it from moving with the sliding jaw, as set forth."

56. For an *Improvement in Spaces for Setting Type;* E. C. Harmon, Troy, New York.

"The nature of my invention consists in the employment of an elastic spring 'space,' of cimi recta, or other suitable shape, the object of said spring space being to facilitate the art of setting type."

Claim.—"What I claim as my invention is, the cimi recta, or other more suitable shaped elastic space for facilitating the art of setting type, or for saving the time and labor usually expended in 'spacing out,' 'thin spacing,' regulating the distance of words in the same line from one another, and 'correcting proof,' in the manner herein set forth."

57. For an *Improvement in the Mode of Generating Heat;* William H [illegible]tell, Kensington, and Jos. Lancaster, Spring Garden, Pennsylvania.

"The nature of our invention consists in the adaptation of, or the rendering available, tar, as a fuel for the production of the intense and steady heat required for the melting or manufacture of glass, by introducing it into the furnace, in combination with water, or the vapor of water."

Claim.—"We do not claim the use of tar as a fuel, as that is well known and practised in the manufacture of gas; but, what we do claim as our invention is, the adaptation

of, or rendering available, tar as a fuel, for the production of the intense and steady heat required for the melting and manufacturing of glass, by introducing water, or the vapor of water, into the furnace, in contact, or in close proximity, or in combination or mixture with the tar, substantially in the manner set forth above."

58. For an *Improvement in Mode of Fastening the Palings to the Rails in Iron Fences;* George Hess, Easton, Pennsylvania.

"The nature of my invention consists in providing the horizontal bars and the palings with quadrants, segments, circles, cylinders, triangles, and other devices cast to them, for the purposes herein described and set forth, making it a fence or railing, for level, rising, or descending ground."

Claim.—"What I claim is, the circular projection, or its equivalent, on the rail and lower part of the paling, in combination with a corresponding cavity on the lower rail, so arranged, that by giving a partial rotation to said rail, the palings will be clamped to the rails, in the manner and for the purpose herein described."

59. For *Improvements in Machinery for Making Wadding;* Hiram T. Lawton, Troy, New York.

Claim.—"Having fully described my improvement in the foregoing drawings and specification, what I claim is, 1st, Ironing the two surfaces of the combined material, after it has been sized and doubled, by giving the iron rollers a reverse motion to that of the bat, for the purpose and in the manner set forth.

"2d, I also claim the arrangement of the frames supporting the sizing and drying apparatus, one above the other, so that the sheets of fibrous material forming the outsides of the wadding, may be more readily sized and dried, independently of each other, and also for the purpose of facilitating the introduction of any number of bats of fibrilous material between the sizing sheets, in order to increase the thickness of the wadding, or batting, substantially in the manner herein described."

60. For an *Improvement in Processes for Preparing Paints;* Heman S. Lucas, Chester, Massachusetts.

Claim.—"What I claim as my invention is, the process of treating magnesian minerals, such as serpentine silicates of magnesia and iron, and similar rocks, by mineral acids, to prepare from the sedimentary or insoluble, or undecomposed portions of such rocks, a mineral product which I call a basis, to be used in the preparation of pigments, substantially as set forth in the specification."

61. For an *Improvement in Harvesters;* John H. Manny, Waddam's Grove, Illinois.

"My invention and improvements relate to the frame of the machine, to the truck by which it is drawn, to the mode regulating the height of the cut from the ground, to the construction of the cutting apparatus, and to the arrangement of the wheel which carries the outer end of the platform, and drives the cutter, with respect to a scraper for clearing the cut grass of the track next the standing grass, in such manner that the track cleared by the scraper, during the cutting of one swarth, shall be run upon by the driving wheel while the next swarth is being cut."

Claim.—"Having thus described my improvements, and indicated some of the modifications of which they are susceptible, what I claim as my invention is, 1st, The arrangement of the track scraper and driving wheel, in such a manner that the latter, while the machine is cutting one swarth, will run in the track cleared by the former, when the machine was cutting the previous swarth, as herein set forth. But in this patent I make no claim whatever to the track scraper itself.

"2d, The projections on the underside of the upper bars of the finger, in combination with the chamber or recess, on the lower inside corners of said bars, to counteract the tendency of wire grass and other fibrous obstructions, to pass in between the cutter bar and the sides of the recess in the upper part of the finger in which it is guided.

"3d, Forming the guard fingers of two parts interlocked at the point, substantially as herein set forth, so that the grass cannot lodge in the joint, and form an impediment to their entering between the stalks of the standing grain.

"4th, In combination with a raker stand or seat, I claim a removable platform, or raking bottom, constructed with a wing that extends from the outer end of the cutter, over the frame, and holds up the butts of the straws above the stubble, which otherwise would obstruct the discharge of the grain from the platform, substantially as herein set forth."

62. For an *Improvement in Printing Presses;* Charles Montague, Pittsfield, Massachusetts.

Claim.—"I do not claim placing the bed plate in a vertical position, as I am aware this has been done before; but what I do claim as my invention is, placing the bed plate in a vertical position, when a reciprocating motion is imparted to it, by which the impressions can be made at each forward movement of the said bed plate, substantially as herein set forth.

"I also claim the combination of the vertically acting bed, with a cylinder or cylinders, arranged in such a manner, that the forward movement of the bed will impart motion to the cylinder or cylinders, to give or take an impression, and allow said cylinder or cylinders to remain stationary, during the return movement of the bed, substantially as herein set forth."

63. For an *Improvement in Boot Trees;* David Sadleir, McWilliamstown, Pennsylvania.

"The nature of my invention consists in forming cavities in the hinder part of a boot tree, and inserting therein a series of levers and friction rollers, which being operated by a screw, and made to expand the tree whilst in the boot, by bearing against the shin piece."

Claim.—"Having thus described my invention, what I claim therein as new is, 1st, The arrangement and combination of the levers, friction rollers, screw, and slide, or their equivalents, with the back part of the tree, which, when contracted, all bed closely therein, as and for the purpose herein described."

64. For an *Improvement in Printing Presses;* Aaron H. Cragin, Martin Buck, James H. Buck, and Franklin A. Tenney, Assignors to Aaron H. Cragin, Lebanon, New Hampshire.

Claim.—"Having described our improved printing press, what we claim therein as new is, 1st, The arrangement and combination of the movements, in connexion with the bed, by which an extent of motion is imparted to the said bed, much larger than that of the sweep of the operating crank, whilst the whole of the said movements only occupy the space within the frame work of the press below the bed, viz:—the pinion shaft, having pinions upon it, which gear into stationary racks made fast to the sides of the frame, and into racks secured to the underside of the bed; the forked lever (or its equivalent) having its forked extremities connected to the said pinion shaft, and its opposite end jointed to the lever that rises from the oscillating shaft, and the pitman connecting the said lever with the crank on the driving shaft, or the equivalents of said movements, when combined and operating, substantially as herein set forth—disclaiming, however, the principle of imparting motion to a printing press, by direct application of power to the bed.

"2d, We claim the combination and arrangement of the pressure cylinder, and the bed, with the conveying bands, the nippers secured to the said bands, and the cams, for operating the said nippers, substantially as herein set forth.

"3d, We also claim the arrangement of the upper and lower tables, with the pressure cylinder, the bed, the conveying bands, the nippers attached to the said bands, and the cams for operating the nippers, in such a manner that an impression can be made at each right and each left movement of the form under the cylinder, and the sheets be deposited, after receiving their impressions, upon the said lower tables, substantially as herein set forth."

65. For *Improvements in Whiffle Tree;* Dewitt C. Williams, Madison, Ohio.

Claim.—"Having described the construction, and also the operation of my improved safety whiffle tree, what I claim as new is, a shaft, with the ends bent at right angles, and the lever, making part of the same, arranged and operating substantially as herein set forth."

NOVEMBER 30TH.

66. For *Improvements in Machinery for Screwing Bolts, &c.;* John Caswell, Assignor to Archibald C. Powell, Syracuse, New York.

Claim.—"What I claim as my invention is, 1st, The movable ways running in yielding bearings back and forth under the machine, and supporting the vise, substantially as set forth.

"2d, The adjustable stop or gauge on the side of the friction nut working in contact with the movable finger, or any similar projection in the die chuck."

67. For an *Attachment for Converting the Ordinary into a Taper Vise;* Jeremy W. Bliss, Hartford, Connecticut.

Claim.—"What I claim as my invention is, an attachment to the vise, substantially as herein described, and for the purposes set forth, which attachment is removable at pleasure, and requires no change in the construction of the vise to which it is applied."

68. For an *Improvement in Hoes;* William C. Finney, Fayette County, Tennessee.

Claim.—"The improvement that I claim as my invention is, the extension of the blade of the common cotton hoe upward and backward, in a curve form, in such form and manner to enable the laborer, by inserting his instrument and pushing it from him, to remove by the cutting edge any grass, weeds, superfluous plants, &c., as described."

69. For an *Improvement in Mortising Machines;* Jos. Guild, Cincinnati, Ohio.

"My improvements consist in an arrangement of mechanism in a mortising machine, whereby the chisel may be brought into instant action, its depth of cut be exactly and constantly controlled by the operator, or suspended, without interfering with the driving power."

Claim.—"What I claim as new is, the sliding wrist connected with the chisel and also with the driving power, in the manner described, in combination with the mechanism described, or its equivalent, for sliding said wrist, so that the operator can, during the motion of the machine, vary the depth of cut of the chisel, or cause it to be suspended, without disconnecting the driving power."

70. For an *Improvement in Endless Belts to Threshing Machines;* John R. Moffitt, Piqua, Ohio.

"The prominent points of improvement in this invention consist in devices for the prompt and thorough separation of the grain from the straw, which, in the usual machinery for this purpose, is liable to carry off and waste a portion of the grain."

Claim.—"Having thus described the nature of my improvements in machinery for threshing and separating grain, I wish it to be understood, that I lay no claim to originality in passing the screening a second time through the threshing apparatus, as that has already been done; neither do I claim the use of a continuous apron with open slats or interstices, for carrying off the straw; but what I claim herein as new is, the continuous open apron, having its belt formed of links, whose cogs are at one part of their rotation (in connexion with the pinions) or means of propulsion, and are, at another part of their rotation (in connexion with the rollers or other stationary objects), a means of agitation of the said apron."

71. For an *Improvement in the Construction of Ploughs;* Fortunatus E. Richardson, Hicksford, Virginia.

Claim.—"In my cultivator plough there are several parts which are common to ploughs, or such as have been more or less separately or in connexion used by others, the central bar or body of the plough, from which is reared the standard or sheath, the angular wings or stirrers confined to the central bar, the double share or mould board: therefore, to these parts no special claim is made, either separately considered, or in combination; but I claim as my improvement, mounting the double pointed share upon the central shoulder piece, and fastening the same by a link piece, as described."

72. For an *Improvement in Rotary Knitting Machines;* Horatio G. Sanford, Worcester, Massachusetts.

Claim.—"What I claim as my invention is, the combination of the mechanism termed the stop motion, with the rotary knitting machinery of the kind as above specified, the object of the stop motion being to arrest the operations of the machine on breakage of the yarn."

73. For an *Improvement in Rotary Knitting Machines;* David Tainter, Worcester, Massachusetts.

Claim.—"I do not claim the combining one or more draft rollers and a take-up roller, or drum, in one frame, which, when put in rotation, shall carry them simultaneously around with it, so as to draw forwards and wind up a rope or cord, or like manufacture, formed of strands twisted together; nor do I claim the application of a take-up roller or mechanism, as used on either a common warp or flat braid knitting machine; but what I

do claim as my invention is, to so combine a draft and take-up roller, and mechanism for revolving it with a rotary series or set of needles, and other mechanism of the above-mentioned peculiar kind for knitting, that such draft roller shall rotate simultaneously, or with the same velocity, with such series of needles, so as to prevent the longitudinal rows of stitches from being produced in helical lines, and the evil consequences resulting to the fabric therefrom.

"I also claim the arrangement of the draft and take-up mechanism, in connexion with the knitting mechanism, supported by two separate frames, and also their connexion with the mechanism for producing an equal and simultaneous rotation of these frames, all substantially as described, whereby there shall not only be no connexion between the frames to extend through the fabric, but no projection from the frame to come in contact with the presser, stitch wheels, and cam bar, or their respective supports, during the simultaneous and equal rotations of both or either of the said frames."

74. For an *Improvement in Cooking Stoves;* Henry J. Ruggles, West Poultney, Vermont.

Claim.—"Having fully described my improvod cooking stove, what I claim therein as new is, the combination and arrangement of the front and rear flues, and air chamber, substantially as herein set forth."

75. For an *Improvement in the Manufacture of Stone and Earthenware;* Jacob and Freeman Wise, Frederickstown, Pennsylvania.

Claim.—"What we claim as our invention is, 1st, The mode of attaching the mandrel so that it may revolve on its axis, by means of friction with the clay, and at the same time be moved from side to side within the mould.

"2d, The model adopted for varying the relative thickness of the different parts of the manufactured article."

Re-Issues for November, 1852.

1. For an *Improvement in Steam Boilers and Apparatus to be used on board of Steam Boats to prevent the Explosion of Boilers;* Cadwallader Evans, Pittsburgh, Pennsylvania; dated April 15, 1839; re-issued November 23, 1852.

Claim.—"Having described my invention and some of its advantages, I would say that I do not claim the use of an alloy to allow steam to escape through the opening in the boiler, caused by its fusion; but I do claim as my invention, the combination of a fusible alloy, confined in a cup, tube, or case, with metallic stem, rod, or other fixture not fusible at the melting temperature of the alloy, which stem, rod, or other fixture is held or kept in position whilst the alloy remains hard, but when said alloy is fused, said stem or its equivalent can move or have motion, by which liberty to move, any valve may be liberated or caused to open and let steam escape, or any alarm may be let off, or any index moved, so that this combination may act as an alarm indicator or safety apparatus.

"I also claim, in combination with said alloy and plug, the heavy slotted weight, the lever, or its equivalent, and the safety or escape valve, and its ordinary weight, acting in the manner and for the purposes herein described."

2. For an *Improvement in Cream Freezers;* Eber C. Seaman, Philadelphia, Pennsylvania; dated October 3d, 1848; ante-dated April 3d, 1848; re-issued November 30th, 1852.

Claim.—"What I claim as my invention is, the arrangement of scrapers at an angle with the bottom and sides of the vessel, as described, so that the action of the rotation shall throw the scrapers against the sides and bottom of the vessel."

3. For an *Improvement in Welding Cast Iron to Malleable Iron or Steel;* Mark Fisher and William Martin, Jr., Newport, Maine; dated October 16th, 1847; re-issued November 30th, 1852.

Claim.—"Having fully described the nature of our improvement, what we claim therein as new is, uniting the steel and cast iron as described, by first preparing the steel in the manner set forth, and then causing the cast iron to flow over and upon the surface of the steel thus prepared, substantially in the manner and for the purpose above set forth."

Designs for November, 1852.

1. For a *Design for a Cooking Stove;* Joseph Pratt, Assignor to Bowers, Pratt & Co., Boston, Massachusetts, November 2.

Claim.—"I claim as new the general ornamental design and configuration, as exhibited

in the drawings, and especially claim the design of each of the fire place doors, and that of the oven doors."

2. For a *Design for a Pump Curb;* John W. Wheeler and Obadiah B. Latham, Seneca Falls, New York, November 2.

Claim.—"What we claim as our invention is, the combination and arrangement of ornamental forms, carvings, and configurations, as represented in the annexed drawing, making an ornamental design for the curb of a chain pump."

3. For a *Design for Stove Plates;* William M. Snow, Providence, Rhode Island, November 2.

Claim.—"What I claim as my production is, the new design consisting of the bead work, mouldings and ornamental configurations herein above described and represented in the drawings, for the side plate of a cooking stove."

4. For a *Design for a Cook Stove;* N. S. Vedder, Troy, New York, November 2.

Claim.—"What I claim as new is, the ornamental design and configuration of cook stove plates, such as herein described, and represented in the annexed drawing."

5. For a *Design for a Parlor Stove;* Washburn Race, Assignor to H. C. Silsby, W. Race, and Birdsill Holly, Seneca Falls, New York, November 9.

Claim.—"What I claim as my invention is, the design and configuration of the several plates, and of the feet, and also of the ornaments separately, as herein shown and described."

6. For a *Design for a Pedestal and Column;* Thomas Law, Assignor to Levi Chapman, City of New York, November 9.

Claim.—"What I claim is, the ornamental design on the pedestal, consisting of the combination of the grapes, leaves, scrolls, and face, in alto or bass relievo, as shown; and also the ornaments for the base, shaft, and capitol of the column, herein described and shown in the accompanying drawing."

7. For a *Design for a Parlor Stove;* Samuel H. Sailor, Assignor to James G. Abbott and Archiles Laurence, Philadelphia, Pennsylvania, November 9.

Claim.—"What I claim as my invention or production is, the ornamental design of the top plate, the bed plate, the grate plate, the door frame, the foot, and the column base of the stove called 'the Radiator,' as fully set forth and described."

8. For a *Design for a Cannon Stove;* Samuel H. Sailor, Assignor to James G. Abbott and Archiles Laurence, Philadelphia, Pennsylvania, November 9.

Claim.—"What I claim as my invention or production is, the new and ornamental design upon the bed plate, the lower part of the body of the stove, the grate plate, the octagon frame, the top plate, and the leg, of the stove called 'the Octagon Cannon,' combined, arranged, and having the configuration, as set forth and fully described."

9. For a *Design for a Stove;* Samuel H. Sailor, Assignor to James G. Abbott and Archiles Laurence, Philadelphia, Pennsylvania, November 9.

Claim.—"What I claim as my invention or production is, the ornamental design upon the front, ends, and feet of the stove, as fully described."

10. For a *Design for Stove Plates;* Samuel H. Sailor, Assignor to James G. Abbott and Archiles Laurence, Philadelphia, Pennsylvania, November 9.

Claim.—"What I claim as my invention or production is, the ornamental design of the oven doors, the clearing door, the feeding door, the ash hole door, and the configuration and arrangement of the mouldings and ornaments of the frames, as set forth and described."

11. For a *Design for a Franklin Stove;* Joseph Pratt, Assignor to Bowers, Pratt & Co., Boston, Massachusetts, November 16.

Claim.—"Having described the parts of the said fire place, and represented the ornamental design of the whole, I claim as new, and of my production, the said ornamental design, substantially as exhibited."

12. For a *Design for a Parlor Grate;* Joseph Pratt, Assignor to Bowers, Pratt & Co., Boston, Massachusetts, November 16.

Claim.—"I claim as new, and of my production, the design and configuration of the

ornaments of the front plate and mantel or top plate of the fire place, the hearth, the fender plate, and the blower, as represented in the drawings, and as above described, the whole forming an ornamental design for a parlor grate."

13. For a *Design for a Parlor Stove;* Dutee Arnold, Providence, Rhode Island, November 30.

Claim.—"What I claim as my production is, the new design, consisting of the ornamental configurations and raised figures herein above described and represented in the drawings for a parlor stove."

14. For a *Design for a Franklin Stove;* Samuel F. Pratt, Boston, Massachusetts, Assignor to Jagger, Treadwell & Perry, Albany, New York, November 30.

Claim.—"What I claim as my production is, the combination and arrangement of ornamental figures and forms represented in the accompanying drawings, forming together an ornamental design for a Franklin Stove."

15. For a *Design for Window Blinds;* Nathan Chapin, Assignor to Nathan Chapin and John F. Briggs, City of New York, November 30.

Claim.—"What I claim is, the design and configuration given the slats of window blinds, as above described, and set forth in the annexed drawing."

DECEMBER 7TH.

1. For *Improved Machinery for Bending Pail Bales, &c.;* Robert Bunker, Rochester, New York.

"The nature of my invention consists in constructing a machine for bending pail bales, by which I can bend from one to twenty, or more, according to the length of the machine, and bend them more perfect and with greater facility than in the ordinary way."

Claim.—"What I claim as my invention is, the combination of the saddle, the brake, the bar, and the movable block, all operating in the manner and for the purpose substantially as herein described and set forth."

2. For an *Improvement in Seed Planters;* Lewis W. Colver, Louisville, Kentucky.

Claim.—"Having fully described my invention, what I claim therein as new is, making the cells in the tops of the grooves made as described, so that they shall carry single grains, and combining therewith a cleaner, which extends into the groove behind the seed, as each cell in turn arrives at or over the seeding tube, for the purpose of carrying around and depositing with a certainty, the seeds of grains, singly, substantially as described."

3. For *Improvements in Saw Gummers;* Richard S. Cramer and Cyrus C. Blossom, Sommerville, Ohio.

Claim.—"What we claim therein as new is, the nut having gudgeons occupying notches in one of the jaws of a saw gumming apparatus, in which the cutting portion is situated between the power and the fulcrum, for the objects explained."

4. For *Improvements in Drilling Machines;* Charles W. Coe, Ashtabula, Ohio.

Claim.—"What I claim as new is, 1st, The peculiar manner of giving the slow automatic feed motion to the spindle, and the fast receding motion, by means of the sliding pinion, collar, and screw which is attached to the spindle, combined with the two sets of cogs, or their equivalents, upon the face of the same disk, the several parts above named being constructed, arranged, and operating in the manner and for the purpose herein shown and described.

"2d, I claim the peculiar method of constructing and arranging the clutch, as herein shown and described, by which the inclination of the clutch may be changed, as described, and the position of the clutch also moved or changed bodily, in a horizontal direction."

5. For an *Improvement in Hats;* Francis Degen, City of New York.

Claim.—"I am aware that metallic rings or bands have been used in helmets and similar articles, for the purpose of a support, but I do not know of any hat in which a strip of foil has been inserted between the leather, or sweat, and the hat; therefore what I claim is, the metallic strip, or strips, inserted between the leather, or sweat, and the hat, and attached to either or both, the hat or sweat, as described and shown."

6. For an *Improvement in Tonguing and Grooving Apparatus;* Phineas Emmons, City of New York.

Claim.—"Having now described my invention and its operation, what I claim, therefore, is, the shaft, connecting rods, cutter stocks and cutters, and slides, in combination with the stationary tongues and grooves, for the purpose of tonguing and grooving boards, &c., as set forth."

7. For an *Improvement in Hot Air Furnaces;* Stephen Gates, Albion, New York.

Claim.—"Having described my invention, I do not claim the employment of a series of upright tubes or flues over a fire chamber, for the purpose of heating air; nor do I claim the use of deflecting plates, simply as such; but I do claim the combination of the deflecting plates with the system of upright flues directly over the fire chamber, when such flues are arranged in the manner set forth, so that each flue of itself shall act as a deflector, and insure a complete circulation through the whole system, substantially in the manner described."

8. For *Improved Machinery for Bending Carpet-Bag Frames, &c.;* Edward L. Gaylord, Newark, New Jersey.

Claim.—"I do not confine myself to the use of any particular mechanism for closing the clamps and griping the bars, nor for drawing them down upon the edge of the bars; but what I claim as my invention is, the employment, for the purpose of bending and forming carpet bag frames, or for bending two or more flat metal bars, edgewise, for any purpose, of a pair of clamps, each moving independently of the other, in the direction of the width of the bars, and having recesses, and self-adjusting movable pieces, as described, combined in any way, substantially as set forth, with a table and bending plate."

9. For an *Improvement in Grain and Grass Harvesters;* C. B. Brown, Griggsville, Illinois.

Claim.—"What I claim as new is, the combination of the crown wheel with the shafts, with their respective pallets, acted upon alternately by the cogs of the wheel, the shafts being connected so as to turn in opposite directions, whereby a vibratory motion is given to the blade.

"I do not claim either of these singly, but when combined for the purposes and in the manner substantially as above described."

10. For an *Improved Galvanic Battery;* Louis Drescher, City of New York.

Claim.—"What I claim as my invention is, the within described improved arrangement of the old voltaic pile, the same consisting in so separating each galvanic pair from that next it, in the series, and connecting them with short wires, and forming the plates with suitable perforations, as that the strips of leather or flannel, or their equivalent, may be at once saturated with the exciting liquid, by immersing the battery therein."

11. For an *Improved Hinge for Moulders' Flasks;* George Grant, Troy, New York.

Claim.—"Having described the construction and operation of my hinge, what I claim as new is, a hinge for moulders' flasks, constructed substantially in the manner as described and represented, by means of which the cope is raised in the jaws of the hinge, as set forth."

12. For an *Improvement in Chairs;* John T. Hammitt, Philadelphia, Pennsylvania.

Claim.—"What I claim as my invention in the above described chair is, operating the leg rest from the motion of the seat and back of the lever and rod, or their equivalent."

13. For an *Improvement in Machines for Manufacturing Hat Bodies;* Lansing E. Hopkins, City of New York.

Claim.—"Having fully described my improved method of planking hat bodies, what I claim therein as new is, 1st, The feeding belts constructed substantially as described, with jointed chains, having cloth stretched between them, as set forth, by which their motion is exactly determined and equal.

"I also claim the combination of the revolving endless planking board or table, with the feeding belts, both moving with the same velocity for the purpose as described."

14. For an *Improved Lock;* Richard Ketcham, Seneca Castle, New York.

Claim.—"What I claim as new is, the circular tumbler, or its equivalent, in combination with the slotted collar, which encompasses the spindle of the knob, said collar and tumbler, or its equivalent, being constructed and operating in the manner substantially as herein described."

15. For an *Improved Padlock;* Rhodolphus Kinsley, Springfield, Massachusetts.

"My improvement consists in the cheapness, convenience, and simplicity of its construction and operation, together with its security against being picked, rendering it valuable for the purposes of railroad cars."

Claim.—"What I claim as my invention is, giving a forward motion to the hasp, and acting upon the tumblers by means of the same key, when the parts are arranged, so that the key acts directly upon a portion of the hasp, substantially in the manner described.

"2d, I claim the double acting spring herein described, only when used in connexion with such a form and arrangement of hasp as will cause it to actuate the tumblers, and not only to throw the hasp out, but hold it thrown out and fully open, in the manner described, confining my claim to this device."

16. For an *Improvement in the Mode of Frosting Glass;* John Levy and Charles Jones, City of New York.

Claim.—"What we claim as our invention is, 1st, Frosting and figuring glass, by fixing the plates to be treated in a trough or vessel containing sand, pebbles, and water, and subjected to a short, quick, vibrating motion, in a longitudinal direction, by any suitable mechanical movement, thus causing the glass to pass through the mass of gritty material before any considerable momentum is imparted to that mass, as more fully set forth herein.

"2d, We claim forming ornaments upon the glass, by the application of patterns, or designs, in connexion with the process of frosting by the action of the sand and pebbles, substantially as set forth herein."

17. For an *Improvement in Manufacturing Wooden Type;* John McCreary, Chesterville, Ohio.

Claim.—"I do not claim the use of a press and dies for the purpose of making wooden type; but what I do claim as new is, the arrangement of the propelling lever, as that by its return movement, in combination with the feeding lever spring, dog and feeding tube, it will move forward as required the blank wood to receive the impression, as above described and set forth."

18. For an *Improvement in Pill Making Machines;* Erasmus A. Pond, Rutland, Ver.

Claim.—"What I claim as my invention is, 1st, Moulding or forming pills by means of two cylinders, having each a number of recesses in its periphery; the recesses in one cylinder matching with those in the other, and each matching pair forming a mould of the required form of the pill, the said cylinders revolving in opposite directions, and the pill mass being conducted between them, substantially as herein described.

"2d, The bands of india rubber, or any sufficiently elastic material, passing round, or partly round, the mould cylinders, for the purpose of expelling the pills from the recesses after the moulds are open, substantially as herein set forth."

19. For an *Improvement in Shingle Machines;* William Stoddard, Lowell, Mass.

Claim.—"Having fully described my improved shingle machine, what I claim therein as new is, 1st, The combination of the rifting knife (connected with the main driver by means of the elastic arms) with the inclined planes, placed upon the rails, as described, for the purpose of enabling the knife to be carried forwards under the block during the forward movement of the said driver, and then be elevated to the proper height to split off a shingle during its return movement, substantially as herein set forth.

"I also claim the arrangement of a secondary driver, placed above and acting independently of the main driver, in such a manner that it will drive the rived shingle from under the block, and deposit it upon the bed forward of the main driver, in such a position that it will be carried forwards to be dressed during the forward movement of the said driver, substantially as set forth."

20. For an *Improved Screw Driver;* Jacob W. Switzer, Basil, Ohio.

"The nature of my invention consists in combining with the ordinary brace and bit stock a self holding screw driver, constructed substantially in the manner as hereinafter

described, for holding the screw firmly, while the operation of driving or withdrawing it is carried on."

Claim.—"What I claim as my invention is, the screw driver spring catches, attached to the flat portions of the screw driver, and permitting longitudinal as well as lateral adjustment, and the barrel in which the whole is placed, in combination with the brace and stock, or their equivalents, the whole being constructed and arranged, and operating in the manner and for the purpose substantially as herein set forth."

21. For an *Improvement in Reels for Harvesters;* Warren W. and Clark C. Wright, Canton, Pennsylvania.

Claim.—"What we claim as our invention is, 1st, Extending the axle of the driving wheels so far beyond the carriage as may be necessary to form a pivot for the reels to turn upon and allow of its rotation, by a band, as described, independent of the rotation of the axle, substantially as set forth."

22. For an *Improvement in Utilizing Slags of Furnaces;* William H. Smith, Philadelphia, Pennsylvania.

Claim.—"What I claim as my invention, so as to have the exclusive right therein, is, the process of utilizing the slags of iron and other like furnaces, refining and working the same, substantially in the manner and for the purposes set forth in the specification, whereby I bring into successful operation, for useful purposes, a class of hitherto useless products."

23. For *Improvements in Machinery for Making Wood Screws, &c.;* Cullen Whipple, Assignor to the New England Screw Company, Providence, Rhode Island.

Claim.—"Having described my improved machinery for the manufacture of screws, what I claim therein as new is, 1st, The feeder, composed of a sectional trough, with a close bottom and open top, into which the blank drops and arranges itself before a traversing rod, which pushes it into the griping jaws, substantially as described.

"2d, The combination of the traversing rod, actuated substantially as described, with an adjustable stop for the purpose of setting the blank between the jaws, in the exact position required, as herein set forth.

"3d, The method of operating the jaws and holding them closed with the requisite force to hold the blank firmly between them, without end strain upon the mandrel, by means of toggle or knuckle end joint levers, which are thrown slightly past centres, when the jaws are closed to hold them closed, when they are used in connexion with elastic and long shanked nippers, substantially as herein described, whereby all end strain of the mandrel against its bearings is prevented during and by the griping and holding of the blank.

"Lastly, I claim the spring discharging punch, constructed and arranged in such manner, that the same shall be compressed by the entrance of the blank between the griping jaws, and shall throw the blank out of the jaws the instant they relax their hold of it sufficiently; such pushing out depending upon such relaxation and the force of the spring, and being entirely independent of the motion of any other part of the machine."

MECHANICS, PHYSICS, AND CHEMISTRY.

Translated for the Journal of the Franklin Institute.

Liquid and Unchangeable Glue. By M. de Dumoulin.

As this glue is very convenient for cabinet-makers, carpenters, and others, inasmuch as it is applied cold, and does not require heating, I give the method of preparing it to the public:—

Take of strong glue 1 kilogramme, (2·2 lbs. Av., 2·7 lbs. Troy,) dissolve it in 1 litre (1 quart) of water, in a glazed pot on a slow fire, or better still, over a water bath; stir carefully from time to time. When all the glue has melted, add little by little 200 grammes (6.5 oz. Troy) nitric acid, spec. grav. 1.33. This addition produces an effervescence due to

the disengagement of nitrous acid. When all the acid is poured in, the vessel is removed from the fire and suffered to cool. I have preserved glue thus prepared for more than two years in an uncorked bottle, and during this time it underwent no change.—*Comptes Rendus de l'Acad. des Sciences, September*, 1852, *p.* 444.

For the Journal of the Franklin Institute.

Steam Logs of the Steamship "Arctic," belonging to the Collins Line of U. S. Mail Steamers between New York and Liverpool. By B. F. Isherwood, Chief Engineer, U. S. Navy.

(*With a Plate.*)

By the kindness of Chief Engineer Daniel B. Martin, U. S. Navy, I have obtained copies of the steam logs of the *Arctic*, for the time he was Chief Engineer of her; and believing that the detailed performance of so celebrated a vessel would be generally acceptable, I have prepared them for the *Journal*, and added the dimensions of the hull, machinery, &c. From the same hands, I obtained the dimensions of the paddle wheels, and also a large number of indicator diagrams, showing exactly the power exerted by the engines, and the volume of steam used. The drawing of the boiler is from actual measurement, taken on board the vessel for this publication. It is believed, therefore, that the data and results here presented are as near the truth as it is possible to approximate, and even much nearer than is required for any practical purposes. It is possible that the dimensions of the hull may not be accurate to an inch, but I believe them to be correct.

Hull.—Length on deck,	286 feet.
Length between perpendiculars,	280 "
Beam on deck, extreme,	46 "
Depth below main deck,	24 "
Depth below spar deck,	32 "
Burthen,	2878 tons.
Mean draft of water on leaving port,	20 feet 3 inches.
" " arriving at port,	17 " 6 "
Average draft for the voyage,	19 "
Immersed amidship section at 19 feet draft,	685 square feet.
Displacement at 19 feet draft,	3724 tons.
" 17 feet 6 inches draft,	3368 "
" per inch of draft at 19 feet draft,	22 "
" " " 17 feet 6 inches draft,	20½ "
Angle of entrance at load line,	36°
" " launching line, (forward 8 feet 11 inches, aft 10 feet 5 inches,)	26°
" clearance at load line,	25°
" " launching line,	22°
Weight of the hull,	1380 tons.

The hull is braced by iron bars, 45 feet long, and 6 inches by 1 inch in section, placed 4 feet from centre to centre. The bars run in both directions, and cross at an angle of 45°; at each crossing they are riveted together.

Engines.—Two side lever condensing engines.	
Diameter of cylinders,	95 inches.
Stroke of pistons,	10 feet.
Space displacement of both pistons per stroke,	984·48 cubic feet.

PADDLE WHEELS.—Of the common radial kind.

Diameter from outside to outside of paddles,	34 feet 5 inches.
Length of paddle,	11 " 6 "
Width "	21½ "
Immersion of lower edge of paddle at 19 feet draft,	6 " 6 "
Number of paddles in one wheel,	36.
" " in water in one wheel,	10.
Area of two paddles,	41·208 sq. feet.
Area of all immersed paddle surface,	412·08 "
Proportion of the area of two paddles to area of immersed amidship section of hull,	1·000 to 16·623.
Proportion of the area of all immersed paddle surface to area of immersed amidship section of hull,	1·000 to 1·662.

BOILERS, (*Plate II.*)—Four iron boilers, with vertical tubes. The water is contained within and the fire is applied without the tubes. The boilers are placed in pairs back to back, with one smoke chimney in common; each pair has its own fire room. The forward and after pair are alike, except in breadth and number of tubes; each forward boiler being 14 feet broad, and containing 1332 tubes; and each after boiler being 15 feet broad, and containing 1480 tubes; making a total of 5624 tubes in the four boilers. These tubes are of iron, and 2 inches in external diameter; 2812 are 5 feet long, and 2812 are 4 feet 6 inches long. Distance in clear between tubes lengthways the boiler, 0·944 inch; crossways the boilers, 1·591 inch.

Length of each boiler,	20 feet 7 inches.
Breadth of each forward boiler,	14 "
" " after "	15 "
Height of each boiler, exclusive of steam chimney,	13 " 8 "
Area of heating surface in the furnaces of the two forward boilers,	1204 square feet.
" " tubes "	7323 "
" " tube boxes "	500 "
" " smoke connexions "	263 "
" " furnaces of the two after boilers,	1242 "
" " tubes "	8137 "
" " tube boxes "	538 "
" " smoke connexions "	277 "
Total heating surface in the four boilers,	19,484 "
Area of grate surface in the two forward boilers,	279·555 "
" " after "	308·333 "
Total area of grate surface in the four boilers,	587·889 "
Aggregate cross area of the spaces between the tubes in the two forward boilers,	55·685 "
" " " " after boilers,	61·250 "
Total aggregate cross area of the spaces between the tubes in the four boilers,	116·935 "
Aggregate cross area beneath the hanging plate at back of boiler in the forward boilers,	83·000 "
" " " " after "	92·000 "
Total " " " " four "	175·000 "
Cross area of the smoke chimney,	78·540 "
Height of the smoke chimney above the grates,	75 feet.
Capacity of the steam room in the four boilers,	4350 cubic feet.
Weight of sea water contained in four boilers, by calculation,	392,300 pounds.
PROPORTIONS.—Heating to grate surface,	33·142 to 1·000
Grate surface to aggregate cross area of spaces between tubes,	5·028 "
" " " beneath the hanging plate,	3·359 "
" to cross area of smoke chimney,	7·485 "

Seventh Voyage from New York to Liverpool.

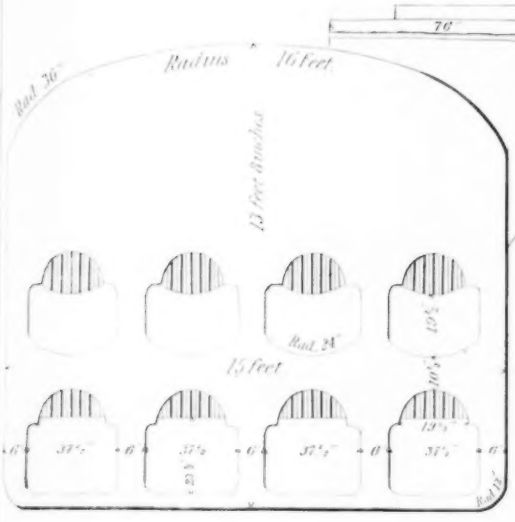
Date.	Average steam pressure in boiler per sq. in. above atmosphere in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	Remarks.
Dec. 21, '51.	11·0	12·32	15160	20 30	65	227	40° 21′	69° 28′	
" 22, "	11·7	12·66	18039	23 45	72	274	42 02	63 52	
" 23, "	15·0	13·31	18835	23 35	91	247	44 31	59 39	
" 24, "	15·0	13·73	19426	23 35	91	290	45 58	52 56	
" 25, "	14·4	11·75	16414	23 17	81	232	47 51	48 06	
" 26, "	14·0	11·91	16734	23 25	83	253	49 31	42 26	
" 27, "	12·5	12·12	17093	23 30	85	272	51 34	36 14	
" 28, "	13·0	11·29	15976	23 35	80	232	51 58	30 08	
" 29, "	11·3	13·10	18450	23 28	77	271	52 12	22 52	
" 30, "	13·0	15·05	21299	23 35	89	301	51 20	15 03	
" 31, "	12·7	15·25	21312	23 18	82	294	55 55	7 36	
Jan. 1, '52.	13·3	16·20	17208	17 42	57	237			
Totals,			215946	273 15	953	3130			
Means,	13·3	13·172			7812lb. per. hr.	11·455 per h'r.			

Seventh Voyage from Liverpool to New York.

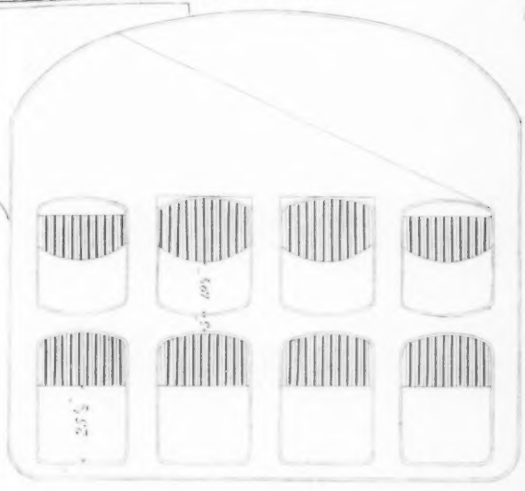
Jan. 8, '52.	14·1	10·19	15508	25 22	75	194			
" 9, "	13·6	9·80	14332	24 22	56	185	51° 17	12 23	
" 10, "	14·3	11·57	16976	24 27	73	258	51 38	19 15	
" 11, "	15·3	10·92	15891	24 15	78	177	51 25	24 02	
" 12, "	15·0	11·50	16764	24 19	76	244	50 46	29 43	
" 13, "	15·4	13·00	19005	24 23	84	264	50 06	36 30	
" 14, "	10·4	8·36	12264	24 27	64	115	49 00	38 51	
" 15, "	13·3	11 90	17133	24 00	74	209	47 40	43 36	
" 16, "	16·7	14·26	20807	24 19	86	295	45 54	50 00	
" 17, "	15·7	13·91	20310	24 20	85	252	45 10	56 02	
" 18, "	15·4	11·72	17132	24 22	77	184	44 19	60 15	Arriv'd and stopped off the Light Ship at midnight, losing 4¼hs
" 19, "	16·7	15·22	22228	24 20	75	307	41 51	66 11	
" 20, "	15·1	13·29	19500	24 28	70	243	40 22	70 57	
" 21, "	15·0	15·90	13354	14 00	57	166			
Totals,				331 24	1030	3093			
Means,	14·7	12·131			6962lb. per h'r.	9·333 per h'r.			

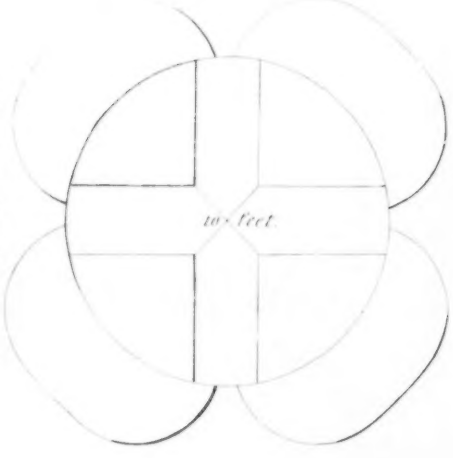
A

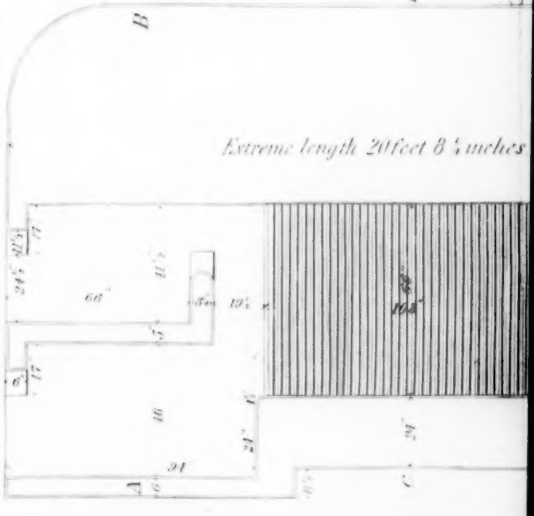
Front Elevation



Section A B

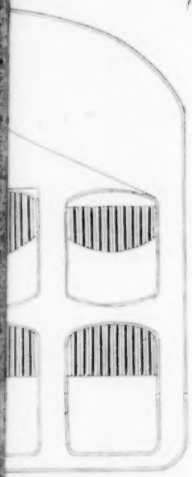


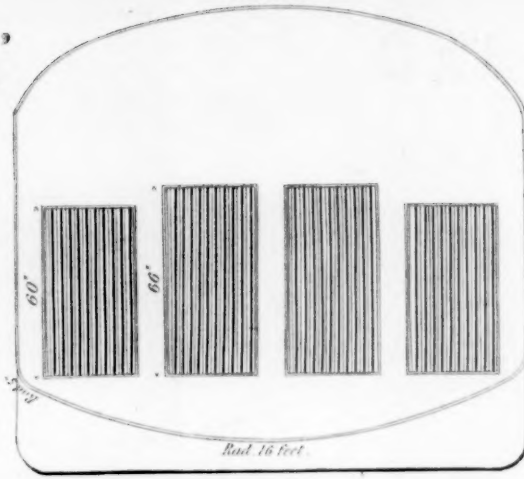


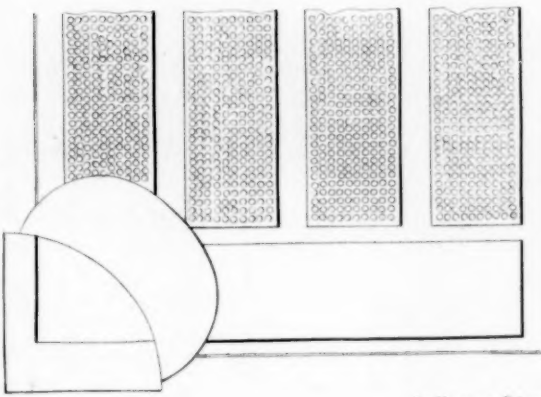


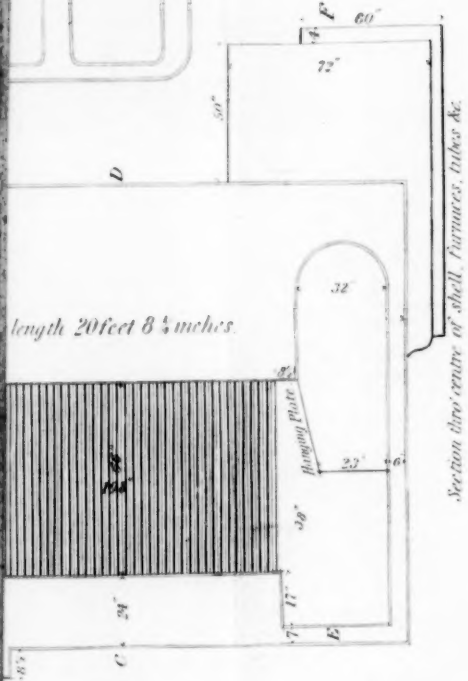
'ARCTIC.'

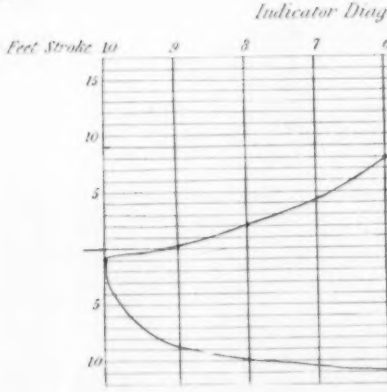
(Collins Line.)

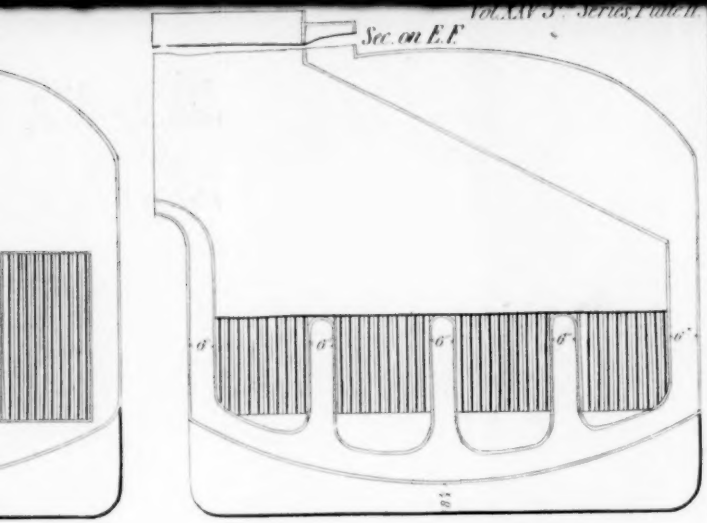


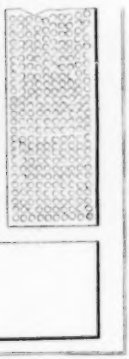








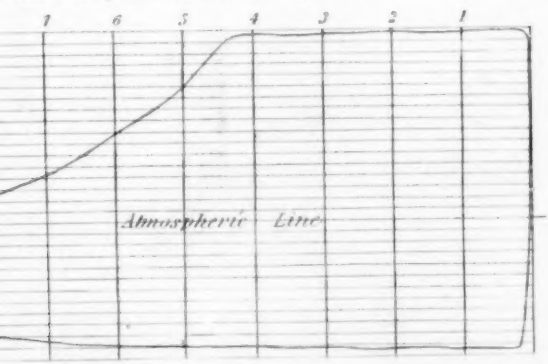




Top view of back part of boiler with crown of shell removed.

'ARCTIC'

dicator Diagrams from Steam Cylinders.



Eighth Voyage from New York to Liverpool.

DATE, 1852.	Av. steam pres. in boil. per sq. in. above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made per min. (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Feb. 8	17·0	14·42	20550	23 45	85	300	40° 46′	67° 55	Mod fair wind & sea.
" 9	16·7	14·30	20167	23 30	75	310	42 22	61 34	Mod. wind & sea on qr
" 10	17·5	15·35	21704	23 34	80	325	45 15	54 34	" " "
" 11	17·5	15·90	22419	23 30	88	331	46 55	47 22	" " "
" 12	17·0	15·84	22254	23 25	89	336	49 28	39 56	" " "
" 13	16·1	15·34	21497	23 21	89	238	50 52	34 10	Heavy sea and fresh wind on quarter.
" 14	17·0	16·44	23104	23 25	92	316	51 02	25 47	" " "
" 15	17·0	16·72	23440	23 23	90	307	51 00	17 39	" " "
" 16	16·7	16·57	23237	23 23	91	301	Cape		" " "
" 17	16·5	16·08	22594	21 25	87	295	Clear, 1 mile.		Ship rolling badly, and engines racing.
Totals,			220966	232 41	866	3059			
Means,	16·9	15·828			8337lb. per h'r.	13·146 per h'r.			

Eighth Voyage from Liverpool to New York.

Feb. 26	17·5	13·46	18575	23 00	80	290			
" 27	17·0	13·46	19653	24 20	85	303	51° 20′	17° 18′	Fair weather; sail set.
" 28	17·1	13·70	20238	24 37	94	306	50 58	25 21	Wind ab'm, ship rol'g
" 29	17·0	13·82	20306	24 30	94	299	50 02	32 56	" " "
Mar. 1	16·6	12·57	18258	24 13	88	262	48 42	39 17	Strong h'd wind & sea.
" 2	14·8	9·72	14184	24 20	71	136	48 02	42 31	Strong gale ahead. and head sea.
" 3	15·5	10·58	15319	24 08	75	186	46 46	46 56	" " "
" 4	16·7	12·22	17727	24 10	86	202	45 34	51 12	Moderate " "
" 5	17·2	14·32	20813	24 14	92	256	43 59	56 48	" " "
" 6	16·5	15·03	21972	24 22	89	315	42 30	63 36	Moderate variable wind; smooth sea.
" 7	17·0	15·34	22400	24 20	91	312	41 37	70 02	Mod variable wind; smooth sea; sail set part of the time.
" 8	16·0	15·00	15707	17 30	65	219			
Totals,			225152	283·44	1010	3086			
Means,	16·6	13·226			7974lb. per h'r.	10·877 per h'r.			

Ninth Voyage from New York to Liverpool.

DATE. 1852.	Average steam pressure in boiler per sq. in. above atmosphere in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Mar. 21	17·0	13·82	19480	23 30	85	300	40° 53′	68° 00′	Wind moder. and fair.
" 22	17·8	14·37	20256	23 29	90	308	40 23	61 20	" " "
" 23	17·5	14·26	20107	23 30	98	280	44 00	55 23	Wind light ahead: heavy head sea
" 24	17·0	14·08	19843	23 29	90	270	45 41	42 27	Strong " " " "
" 25	17·5	14·05	19818	23 30	83	268	47 24	43 35	" " " " "
" 26	17·3	14·32	20232	23 33	82	260	49 38	38 02	" " " " "
" 27	17·2	15·02	21173	23 30	90	282	50 56	30 55	Fresh " " " "
" 28	16·9	13·19	18577	23 28	77	228	51 00	24 59	Mod gale ah'd " "
" 29	16·5	13·48	19005	23 30	69	204	50 52	19 38	Strong gale ah'd " "
" 30	16·5	15·93	22371	23 24	77	297	51 01	11 05	Mod h'd wind, h'vy sea
" 31	17·0	17·09	23819	23 13	83	307	51 01	5 05	" " h'vy sea ab'm
April 1	18·0	18·62	6555	5 52	33	79			" " Smooth sea
Totals,			231236	263 58	957	3083			
Means,	17·1	14·600			8121lb. per h'r.	11·680 per h'r.			

Ninth Voyage from Liverpool to New York.

April 8	17·7	13·90	19152	23 00	85	303	*	*	
" 9	17·5	13·80	20316	24 32	82	305	51° 20′	17° 43′	Fresh br. aft, mod sea.
" 10	17·1	13·43	19737	24 30	85	302	50 42	25 39	Fresh br. ab'm h'vy "
" 11	17·4	13·90	20361	24 25	87	274	49 41	32 35	Light wind ah'd " "
" 12	17·5	14·18	20730	24 22	88	260	48 14	38 50	Mod wind ah'd mod "
" 13	17·2	13·24	19410	24 26	84	243	46 56	44 24	H'vy wind ah'd h'vy "
" 14	17·0	12·99	19021	24 25	74	258	45 39	50 18	Mod wind ah'd " "
" 15	17·6	15·35	22557	24 30	87	325	44 06	57 17	Fresh fair wind mod "
" 16	17·5	16·02	23552	24 30	89	330	42 11	64 23	Mod fair wind, " "
" 17	17·0	15·00	21997	24 28	86	272	40 07	69 47	Strong gale ah'd " "
" 18	17·5	17·00	16320	16 00	59	218			
Totals,			223153	259 08	906	3090			
Means,	17·3	14·353			7832lb. per h'r.	11·924 per h'r.			

*Seven miles West of Cape Clear; from the Rock to Cape Clear, 22 hs. 29 min.

Tenth Voyage from New York to Liverpool.

DATE 1852.	Average steam pressure in boiler per sq. in. above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude	REMARKS.
May 2	16·0	13·44	15850	19 39	80	225	41° 34′	69° 40′	Lost 4 hours by fog.
" 3	16·0	13·01	18340	23 30	81	276	41 48	63 49	Light head wind.
" 4	17·0	14·08	19856	23 30	87	268	42 30	58 14	" " " mod sea
" 5	17·0	14·49	20356	23 25	87	298	46 02	52 11	" " " "
" 6	16·9	14·96	21143	23 33	89	298	48 16	45 47	" fair " "
" 7	16·6	14·74	20819	23 32	89	306	50 25	34 44	Fresh " " "
" 8	16·9	14·97	20990	23 22	85	298	51 04	30 56	" " " "
" 9	16·9	15·62	21907	23 22	87	315	51 05	22 35	" " " "
" 10	16·9	15·59	21849	23 21	91	302	50 47	14 37	" " " "
" 11	16·2	15·91	22357	23 25	86	310			At 8 h 44 m abreast of Holyhead, thence slow, stopping at times, and at 3h 9m passed the Rock.
" 12		15·98	14273	14 53	58	185			
Totals,			217740	245 32	920	3081			
Means,	16·6	14·780			8393lb. per h'r.	12·556 per h'r.			

Tenth Voyage from Liverpool to New York.

May 20	16·5	13·61	20830	25 30	85	320	51° 22′	10° 13′	Light w'd a bm mod sea
" 21	17·0	13·35	19535	24 24	77	300	50 49	18 04	" " " "
" 22	16·8	14·32	21096	24 33	79	318	49 54	26 05	" " " "
" 23	17·1	14·85	21749	24 25	79	310	49 28	34 08	Strong h'd w'd h'vy "
" 24	17·4	14·52	21394	24 33	81	288	48 43	41 23	" " " "
" 25	17·0	14·70	21446	24 19	84	280	47 50	48 14	Mod gale ah'd " "
" 26	17·2	14·12	20608	24 20	80	262	45 56	53 49	Strong gale ah'd " "
" 27	16·6	13·64	19805	24 12	80	241	44 16	58 58	Mod fair wind, mod. "
" 28	16·7	16·10	23510	24 20	84	322	41 24	65 07	Calm
" 29	16·4	16·44	23968	24 18	84	336	40 16	72 05	Ar'vd off Light Ship 6 p. m; weather foggy: laid to till next morn'g, and arrived at dock at 7½ hour.
" 30	16·7	18·13	8703	8 00	50	112			
Totals,			222644	252 54	863	3089			
Means,	16·9	14·672			7644lb. per h'r.	12·214 per h'r.			

Eleventh Voyage from New York to Liverpool.

DATE. 1852.	Average steam pressure in boiler per square inch above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
June 13	14·0	12·65	17817	23 28	80	259	40° 53′	68° 43′	Fair wind: smooth sea
" 14	16·0	13·31	18775	23 30	82	278	42 10	62 42	Light wind " "
" 15	16·2	13·50	19130	23 37	86	263	44 02	57 23	Light head w'd " "
" 16	16·7	14·33	20228	23 32	90	283	45 55	51 23	" " " "
" 17	14·6	13·87	19636	23 35	90	276	48 12	43 34	" " " "
" 18	15·4	14·76	20914	23 37	92	325	50 02	37 39	" " " "
" 19	14·0	14·05	19858	23 33	91	321	51 11	29 39	Light wind abm mod "
" 20	13·8	14·41	20193	23 21	89	300	51 06	21 49	Fresh fair wind " "
" 21	15·4	14·82	20859	23 27	88	300	51 06	14 10	Light var. " " "
" 22	15·6	15·04	21160	23 27	90	306			Fresh w'd ab'm " "
" 23	14·0	15·03	12525	13 53	45	181			At 12hs 56m pass'd the Rock Light
Totals,			211095	249 00	923	3092			
Means,	15·1	14·130			8303lb. per h'r.	12·418 per h'r.			

Eleventh Voyage from Liverpool to New York.

July 1	16·0	12·19	19324	26 25	85	258	55° 22′	8° 40′	Gale ahead; heavy sea
" 2	17·0	11·57	16851	24 17	86	222	55 10	15 06	" " " "
" 3	17·0	13·00	19056	24 26	88	269	54 23	22 50	" " " "
" 4	17·1	12·84	18826	24 26	85	248	53 18	29 26	" " " "
" 5	16·7	13·03	19118	24 27	89	257	51 34	36 00	" " " "
" 6	16·6	13·56	19865	24 25	86	258	50 02	42 18	Strong br. ah'd " "
" 7	16·9	14·40	21044	24 21	89	314	47 56	49 34	Mod. br ah'd mod. "
" 8	16·7	15·03	22042	24 27	91	336	45 24	56 44	Light br ah'd, " "
" 9	17·0	15·55	22729	24 22	94	274	43 28	62 24	" " " "
" 10	16·2	15·76	23069	24 24	95	304	40 38	67 52	Mod br. ah'd, " "
" 11	14·0	14·47	21096	22 18	85	278			Ariv'd at Sandy Hook in the morn; weather very foggy; at noon broke away, & pass'd the Hook; at 1h 20m ran ashore at the Narrows; at 2 hs arrived at dock.
Totals,			223020	268 18	973	3018			
Means,	16·5	13·854			8124lb. per h'r.	11·249 per h'r.			

Twelfth Voyage from New York to Liverpool.

DATE. 1852.	Average steam pressure in boilers per square inch above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made (by counter.)	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Aug. 8	15·0	12·00	17060	23 42	75	257	40° 41′	68° 50′	Light wnd; smooth sea
" 9	15·5	13·12	18502	23 30	85	265	42 08	63 20	" " "
" 10	16·2	13·41	18966	23 34	84	271	44 01	57 45	" " "
" 11	14·4	13·11	18622	23 40	81	268	46 00	52 05	" " "
" 12	15·2	13·67	19256	23 28	87	269	48 29	46 31	" " "
" 13	15·0	14·01	19724	23 28	87	280	50 28	40 07	" " "
" 14	14·5	14·56	20424	23 31	91	288	51 22	32 40	" " "
" 15	14·2	14·37	20111	23 19	92	298	51 08	24 50	" " "
" 16	13·8	14·51	20490	23 32	90	302	51 00	16 53	" " "
" 17	13·0	15·12	21284	23 28	89	278			" " "
" 18	14·0	15·21	21038	23 3	88	300			" " "
Totals,			215477	258 15	949	3076			
Means,	14·6	13·906			823 lb. per h'r.	11·911 per h'r.			

Twelfth Voyage from Liverpool to New York.

Aug. 26	17·0	13·63	16352	20 00	75	247			Light wnd; smooth sea
" 27	15·0	12·21	17850	24 21	70	258	50° 50′	14° 56′	Mod head wind mod "
" 28	16·0	13·13	19233	24 25	87	238	51 12	21 13	Strong h'd wind, h'y "
" 29	16·7	13·55	19839	24 24	90	264	50 43	28 11	" " " " "
" 30	16·3	14·37	20987	24 21	94	301	49 59	35 51	Mod " " mod "
" 31	16·0	12·29	17923	24 19	90	203	49 09	40 58	Gale ahead heavy "
Sept. 1	14·0	11·68	17025	24 18	82	200	47 26	45 14	" " " "
" 2	15·2	14·31	20883	24 19	87	292	45 47	51 54	Mod wind abm mod "
" 3	14·0	15·25	22281	24 21	90	314	43 50	58 42	Mod wind ah'd mod "
" 4	13·0	15·23	22239	24 20	86	310	41 54	65 15	" " " "
" 5	10·3	13·95	20376	24 21	86	296	40 36	71 26	" " " "
" 6	9·9	16·16	8723	9 00	36	138			" " " "
Totals,			223711	272 29	973	3061			
Means,	14·6	13·683			7998 lb. per h'r.	11·233 per h'r.			

Summary of the Steam Log. From New York to Liverpool.

Voyage.	DATE.	TOTALS. No. of double strokes of piston made.	TOTALS. Time from dock to dock; Hours and minutes.	TOTALS. Coal consumed in tons of 2240 pounds.	TOTALS. Geographical miles run by observation.	MEANS. Steam pressure in boilers per square inch above atmosphere in pounds.	MEANS. Number of double strokes of piston made per min.	MEANS. Coal consumed per hour in pounds.	MEANS. Speed per hour in geographical miles.
7th.	December, 1851.	215946	273 15	953	3130	13·3	13·172	7812	11·455
8th.	February, 1852.	220966	232 41	866	3059	16·9	15·828	8337	13·146
9th.	March, "	231236	263 58	957	3083	17·1	14·600	8121	11·680
10th.	May, "	217740	245 32	920	3081	16·6	14·780	8393	12·556
11th.	June, "	211095	249 00	923	3092	15·1	14·130	8303	12·418
12th.	August, "	215477	258 15	949	3076	14·6	13·906	8231	11·911
	Means,	218743	253 47	928	3087	15·6	14·403	8199½	12·194

From Liverpool to New York.

7th.	January, 1852.	241204	331 24	1030	3093	14·7	12·131	6962	9·333
8th.	Feb & Mar "	225152	283 44	1010	3086	16·6	13·226	7974	10·877
9th.	April, "	223153	259 08	906	3090	17·3	14·353	7832	11·924
10th.	May, "	222644	252 54	863	3089	16·9	14·672	7644	12·214
11th.	July, "	223020	268 18	973	3018	16·5	13·854	8124	11·249
12th.	August, "	223711	272 29	973	3061	14·6	13·683	7998	11·233
	Means,	226481	277 59½	959⅛	3073	16·1	13·653	7755⅔	11·138
	Means of means,	222612	265 53	943 7/12	3080	15·85	14·028	7978	11·666

Remarks on the Steam Log.

An inspection of the preceding "summary," shows the voyages from New York to Liverpool to be on an average 24 hours and 12 minutes shorter than the average of the voyages from Liverpool to New York. The length of the route or distance run can be taken to be the same in both directions, the means by observation differing only 14 miles, or less than half of one per cent. of the lesser distance; but the voyage from New York to Liverpool required on an average 7738 less revolutions of the wheels, than the average voyage from Liverpool to New York. In the latter case, therefore, the slip of the wheels was 2·99 per cent. more than in the former; the slip in the latter case being 20·86 per cent., and in the former case 17·87 per cent. The consumption of coal also is less in the voyages from New York to Liverpool, by an average of 31⅛ tons; but the consumption of coal per hour is greater by 221½ pounds.

The difference in the performance of the vessel for the easterly and westerly passages, is probably caused by the greater prevalence of westerly winds. The distance from the Battery, New York, to Liverpool, by Mercator and great circle, is 3023 geographical miles; by Mer-

cator, 3084 geographical miles. The mean, therefore, of 3080 miles, made by the *Arctic*, shows very excellent navigation.

Coal.—The coal used in the voyages from New York to Liverpool was the Pennsylvania anthracite; in the voyages from Liverpool to New York, the Welch coal of similar chemical composition.

Evaporation by the Pennsylvania Anthracite.—The cut-off used in the *Arctic* was Stillman & Allen's; it was adjustable, and frequently changed within short limits, as circumstances of weather, quality of fuel, &c., required; the object being to run with a *wide throttle* and maximum boiler pressure. The average point of cutting off was four feet four inches from the commencement of the stroke, and the steam space comprised between the cut-off valves and pistons of the two cylinders, at one end, is, as near as I have been able to obtain it, 25 cubic feet, which I believe is exact. This would make the bulk of steam used in both engines per stroke 451·608 cubic feet. The number of double strokes of piston per minute was 14·403, making the bulk of steam used per minute 13009·02 cubic feet. To this must be added the loss by *blowing off* in sufficient quantities to maintain the sea water in the boilers at $1\frac{3}{4}$ the natural concentration. From the data given in Regnault's experiments, this loss would be as follows—the temperature of the feed water being maintained at 110° Fah., and the average steam pressure in the boilers being 15·6 pounds per square inch above atmosphere, or 30·3 pounds total pressure. The total heat of steam of this pressure is 1158·34° Fah., of which 110° were furnished by the feed, leaving 1048·34° to be furnished by the fuel to the three parts of the water evaporated. The temperature of steam of 30·3 pounds being 252·2° F., and the temperature of the feed 110° F., there was (252·2 — 110 =) 142·2° F. to be supplied by the fuel to the four parts blown out; and

$$\begin{aligned} 1048{\cdot}34 \times 3 &= 3145{\cdot}02 \\ 142{\cdot}20 \times 4 &= 568{\cdot}80 \end{aligned}$$

and 3713·82° equals total heat,

supplied by fuel, of which 568·80° is 15·32 per cent., and is lost by *blowing out*, leaving 84·68 per cent. of the fuel utilized in evaporation, and if 84·68 per cent. evaporated 13009·02 cubic feet per hour, 100 per cent. would evaporate 15362·57 cubic feet. The mean of a large number of indicator diagrams gives the initial cylinder pressure 2 pounds less than the boiler pressure, making it 28·3 pounds per square inch, and the relative of bulks of steam of this pressure and the water from which it is generated is as 932 to 1: $\frac{15362{\cdot}57}{932} = 16{\cdot}4834$, which, taking the weight of distilled water at $62\frac{1}{2}$ pounds per cubic foot, becomes 1030·2125 pounds of steam evaporated per minute, or 61812·75 pounds per hour by $8199\frac{1}{2}$ pounds of coal, *which is 7·539 pounds of steam evaporated per hour from sea water of one and three-fourths the natural concentration, by one pound of Pennsylvania anthracite, with temperature of feed water* 110° *F.*

Evaporation by the Welch Coal.—Proceeding in the same manner with

the Welch coal, with the same point of cutting off, and the same difference of two pounds between the initial cylinder and boiler pressure, and making the necessary alterations for the different total and sensible heats of the slightly different steam pressure; there results *an evaporation of* 7·653 *pounds of steam per hour from sea water of one and three-fourths the natural concentration, by one pound of Welch coal, with temperature of feed water* 110° *F.*

The results from the Anthracite and Welch coals agreeing so very closely, it may be concluded the two fuels are of equal value as generators of steam, an agreement we should also be entitled to expect from their closely resembling chemical constitutions, which compare as follows—Professor Walter R. Johnson being the authority for the Anthracite, and the British Commission of De la Beche and Playfair for the Welch coals from the northern part of Wales:

	Pennsylvania Anthracite. Mean of 9 analyses made on Coal from 6 localities.	Welch Coals. Mean of analyses made on Coal from 14 localities.
Fixed Carbon,	88·540	88·882
Volatile matter, including moisture,	5·170	7·279
Sulphur,	0·052	0·912
Earthy matter,	6·510	3·095
Total,	100·272	100·168
Pounds of steam evaporated by 1 lb. of coal, under similar circumstances, with same boilers, engineer, &c., being the mean results from a combustion of 5568 tons of Anthracite and 5755 tons of Welch coals,	7·539	7·653

Performance.—The mean performance of the *Arctic* for the six voyages eastwardly and the six voyages westwardly, being the average of 3190 hours and 38 minutes steaming, is as follows, viz:

Speed of the vessel per hour in geographical miles of 6082¾ feet,	11·666
" " " statute miles of 5280 feet,	13·439
Revolutions of the wheels per minute,	14·028
Slip of the centre of pressure of the paddles,	19·32 per cent.
Oblique action of the paddles,	21·50 "
Steam pressure in boilers per square inch above atmosphere,	15·85 pounds.
Initial steam pressure in cylinders per sq. in. "	13·85 "
Point of cutting off from commencement of stroke,	4 feet 4 inches.
Mean effective pressure per square inch of pistons,	19 pounds.
Horses power developed by the engines,	2290
Consumption of coal per hour,	7978 pounds.
Consumption of coal per 24 hours in tons of 2240 lbs.	85·48 tons.
Consumption of coal per square foot of grate surface per hour,	13·571 pounds.

Indicator Diagram.—The accompanying indicator diagram, (*Plate II.*) is selected from a large number, to show the average performance of the engines, setting of the valves, &c. It was taken from the top of the starboard cylinder, the engines making 14½ double strokes of piston per minute. Steam pressure in boilers above atmosphere, 18½ pounds per square inch. Temperature of hot well 113° Fah. Throttle wide.

For the Journal of the Franklin Institute.

American Porcelain.

It is a matter of some singularity, that in the rapid advance of our manufactures, so little attention has been paid among us to a branch of so much importance as the manufacture of porcelain, an article of which large quantities are used by our people, especially the plain ware, and the raw materials for making which are very abundant and of excellent quality. We see that recently a manufacture of this ware has been established in Connecticut, but we have not as yet seen any of their products, and cannot, therefore, speak of their quality; but we take advantage of this as a fitting opportunity to record the previous establishment of such a manufactory in our own City, which for a time was very successful, both in making a very excellent article of plain porcelain, and in introducing it into extensive use; but finally came to an end, and is now almost entirely forgotten, even in the place where it formerly existed. The following letter will be found interesting to those of our readers who concern themselves with the history of American manufactures.

PROFESSOR FRAZER:

DEAR SIR:—At your request, I give you with pleasure a few of the particulars of the first manufacturer of American porcelain. My brother, William Ellis Tucker, son of Benjamin Tucker, of the City of Philadelphia, was the first to make porcelain in the United States. My father had a china store on Market street, and in the year 1816 he built William a kiln in the yard back of the store, when William commenced painting upon the white ware in the store, and burning it in the kiln; after which he commenced trying experiments with different clays, to see if he could not make the ware; and finally he succeeded in producing an opaque ware, called queensware. He then commenced trying experiments with feldspar and kaolin, to make porcelain; and after many experiments and much labor, he was successful in making a very beautiful porcelain in a small way. He then rented of the City Corporation the old Water Works, at the north-west corner of Schuylkill Front and Chesnut streets. I do not remember the year, but it was prior to the year 1826. On the 23d of October, 1826, he purchased four acres of land, containing a feldspar quarry, and erected a large glazing kiln, enamelling kiln, mills, &c.; but he found it a very different thing to produce china on a large scale. He had kiln after kiln spoiled, until he almost gave up in despair; but with a perseverance that few others had, he continued until his efforts were crowned with success. In the year 1827, he received a silver medal from the Franklin Institute of the State of Pennsylvania, and also in the year 1831, he received one from the Institute of New York, both of which I now have.

In the year 1828, I commenced to learn the different branches of the business, which I did by serving several years apprenticeship to the same. My brother, William Ellis Tucker, died on the 22d of August, 1832, before which time he had, in connexion with Judge Hemphill, erected a

large china factory at the south-west corner of Schuylkill Sixth and Chesnut streets, the store rooms of which were filled with porcelain of his manufacture.

After the death of my brother (William Ellis), Judge Hemphill and myself continued the manufacture of porcelain for some years, until he sold out his interest to a company of eastern gentlemen, who intended to carry on the business on a large scale; but just at that time they were unfortunate in their other operations, and therefore were unable to do anything for the china factory.

On the 2d of October, 1837, I rented the entire factory, with all the fixtures, &c., and continued the business for some time, until I filled a store with porcelain of my own manufacture, which I had taken in Chesnut street, between Seventh and Eighth. I then discontinued the manufacturing of porcelain, and commenced ordering from Europe, which I have regretted ever since.

I have now given you in a rough way the rise and fall of American porcelain at Philadelphia.

With much respect, I remain yours, &c.

THOMAS TUCKER.

Philadelphia, November 27, 1852.

Translated for the Journal of the Franklin Institute.

Memoir on the Consequences to be Deduced from the Experiments of M. REGNAULT, *on the Laws of the Compressibility of the Gases.* By M. AVOGADRO, (*from the Memoirs of the Academy of Sciences of Turin, 2d Series, Vol. XIII.*)

M. Regnault, in his Memoir *On the Compressibility of Elastic Fluids*, which is the eighth of the collection published by him in 1847, among those of the Academy of Sciences, Vol. XXI., (see *Journ. Frank. Inst.*, 3d Series, Vol. XVI, p. 190,) determined experimentally for atmospheric air, hydrogen gas, carbonic acid, and nitrogen, the values of the ratio of the density to the pressure in each of these aëriform fluids, taken at different densities. He found that expressing the pressure or elastic force by r, in metres of mercury, and designating by m, the density which corresponds to each pressure, taking as unity that which belongs to each gas, under a pressure of one metre of mercury, the value of $\frac{r}{m}$, which according to the assumed units must be one for the pressure of one metre, and according to the law of Mariotte, ought to remain constant for all pressures, is greater than one, and increases with the density m, for hydrogen; and on the contrary is less than one, and decreases with the increase in the density for atmospheric air, carbonic acid, and nitrogen. The experiments made by him on this point were at the densities, two, four, eight, and sixteen, and a common and constant temperature of 3° or 4° Cent. (37°·4 to 39°·2 Fahr.) In this elaborate memoir M. Avogadro discusses the various consequences which philosophers have sought to deduce from these experiments, and after examining the

subject fully and carefully, sums up by the enumeration of the following conclusions, to which his reasoning leads:—

1. The law of the compressibility of a perfect gas, (that is, of one free from the influence exercised by the tendency to liquefaction in approaching the density at which this phenomenon takes place,) may be represented by an experimental formula of the form

$$a^{\sqrt[3]{\frac{r}{m}-1}} = m.$$

Where r indicates the pressure in metres of mercury; m, the corresponding density, the unit of density being that belonging to the gas, under a pressure of one metre of mercury; a being a constant for all the gases at a given temperature. This formula may be presented under the form

$$\sqrt[3]{\frac{r}{m}-1} = \frac{log.\ m}{log.\ a} \text{ or } \frac{r}{m}-1 = \frac{(log.\ m)^3}{(log.\ a)^3}$$

According to this formula we have $\frac{r}{m}-1=1$, or $\frac{r}{m}=0$, and consequently the elastic pressure $r=0$, when the density is reduced to $m=\frac{1}{a}$

This formula ought to be substituted for the law of Mariotte, which, in the same notation, would be expressed by $\frac{r}{m}=1$, or $\frac{r}{m}-1=0$, to which the formula would be reduced by making $a=\infty$; consequently $\frac{1}{log.\ a}=0$; that is, by supposing that the pressure only becomes nothing when the density becomes nothing—a supposition which M. A. shows in his memoir to be inconsistent with our physical theories.

2. The value of the constant a, in this formula, must vary with the temperature of the gas. For common temperatures, or more precisely when the temperature is 3 to 4 degrees above the melting point of ice, the value of a, calculated from the experiments of M. Regnault, is 9735·32, or nearly 10,000; hence employing the logarithms of the tables $\frac{1}{log.\ a}=\frac{1}{4}$, and $\frac{1}{(log.\ a)^3}=\frac{1}{64}$: so that the formula for that temperature, under the logarithmic form becomes

$$\frac{r}{m}-1=0{\cdot}015762\ \frac{(log.\ m)^3}{64} \text{ or nearly } \frac{r}{m}-1,=(log.\ m)^3$$

3. All the gases cease to be perfect, and present a value of $\frac{r}{m}$ less than that given by the preceding formula, when they reach a certain limit of density, which varies with the different gases, and which must also vary with the temperature to which the gases are reduced. For the temperature of 3 or 4 degrees (Cent.) above the melting point of ice, this

limit corresponds in hydrogen nearly to $m = 2$, that is, to a density double of that which the gas possesses under a pressure of a metre of mercury; in nitrogen gas, $m = 1{\cdot}25$, and in oxygen gas, so far as can be deduced from M. Regnault's experiments on the air, of which oxygen forms a part, $m = 1$, that is, to the density which it has under a pressure of one metre of mercury. For carbonic acid, and at the temperature indicated, this limit is found to correspond to $m = \frac{1}{4}$ nearly; so that the influence of the tendency to liquefaction begins to show itself in the law of compressibility of this gas, so soon as the density passes $\frac{1}{4}$ of that which it has under the pressure of one metre of mercury.

4. The diminution which the tendency to liquefaction produces in the gases, starting from the limit indicated, in the value of $\frac{r}{m} - 1$, which would be given for each value of m, by the formula for perfect gases, may be represented by an expression of the form $c\,(m - A)^{\frac{9}{8}}$ denoting by A the value of m, at which the influence of this tendency begins to show itself for each gas at the temperature at which it is taken, and by c, a co-efficient, depending on the nature of each gas, which must also vary with the temperature.

At the temperature of 3 or 4 degrees (Cent.) above the melting point of ice, the value of this co-efficient is for hydrogen 0·0008465, for nitrogen 0·0017573, and for oxygen 0·003538 ; these numbers being deduced from the direct experiments of M. Regnault on hydrogen and nitrogen, and from these on the air, for oxygen.

Thus for these gases the complete formula for their compressibility would be :—

For hydrogen, $\frac{r}{m} - 1 = 0{\cdot}015762\,(log.\ m)^3 - 0.00088465\,(m - 2)^{\frac{9}{8}}$

For nitrogen, $= 0{\cdot}015762\,(log.\ m)^3 - 0.0017573\,(m - 1{\cdot}5)^{\frac{9}{8}}$

For oxygen, $= 0.015762\,(log.\ m)^3 - 0.003538\ \ (m - 1)^{\frac{9}{8}}$

As to carbonic acid, in which the influence of the tendency to liquefaction begins to show itself at a density below that which it has under a pressure of one metre of mercury, this circumstance obliges us to modify even the positive part of the formula which supposes the gas perfect, and the complete formula for that gas, at the temperature indicated, may be put under the form

$$\frac{r}{\mu} - 1 = 0{\cdot}015762\,(log.\ \mu)^3 - 0{\cdot}0074716\,(\mu - 0{\cdot}25)^{\frac{9}{8}}$$

where $\mu = 1{\cdot}0053\ m$; and 0·0074716 being the value of c deduced from the experiments of M. Regnault.

In all these formula the negative part, due to the influence of the tendency to liquefaction, disappears of itself, at the limit of the density be-

yond which this influence is shown for each of the gases, and must be suppressed for densities below this, when all the gases must follow the formula of perfect gases.

5. These formulæ give for the pressure r a maximum corresponding to a certain density, beyond which the gases could not sustain a pressure even equal to that which has been already applied to them, and at which, consequently, they must condense into liquids. This maximum of pressure is found to correspond for hydrogen to about the density of 357; for nitrogen, to 181; for oxygen, to 91; and for carbonic acid, to 44; always taking for the unit of density, that of each gas under a pressure of one metre of mercury; so that at these limits of densities respectively, these gases ought to be reduced to liquids, at the temperature of 3 or 4 degrees (Cent.) above the melting point of ice; and the pressure required for that, according to these same formulæ, would be 217 metres of mercury for hydrogen gas, 104 metres for nitrogen, 51 metres for oxygen, and 24 metres for carbonic acid; and this indication is found to be approximately verified for carbonic acid, the only one of these four gases which has heretofore been liquified at ordinary temperatures.—*Archives des Sciences Phys. et Nat., June*, 1852, *p.* 126.

Translated for the Journal of the Franklin Institute.

On the Purification of Iron and Coke from Sulphur.

At the meeting of the French Academy of Sciences, on the 27th September, M. Chevreul read a note upon this subject from M. Calvert, of which the following extracts will give the substance, which appears to be worthy of the attention of our iron manufacturers:—"The sulphur which the iron contains rarely comes from the ore, but from the combustible employed. After many trials, I have discovered that the chloride of sodium, applied in a certain way, and in proper proportions, will decompose the sulphurets present, whether in the ore or in the fuel. This process, which I have employed in three furnaces—two in Scotland and one in Wales—has given me very satisfactory results. In the iron thus obtained the crystals are not found, and the metal acquires a long and very tenacious fibre. I have not been able to ascertain the exact ratio of the tenacities of the purified and unpurified iron, but I have determined the comparative resistance of the two cast irons. I took bars of the irons carefully shaped, having one square inch cross-section and five feet long; I placed them on supports, distant 4 feet 6 inches from each other, and applied on the centre of the bars a gradual pressure, by means of a screw, until the bars broke. The breaking weights were—

Unpurified		Purified	
487	lbs.	556	lbs.
456	"	525	"
487	"	544	"
470	"	562	"
		569	"
		544	"

These irons were analysed, and the unpurified iron contained 0·006 sulphur, while the purified contained only 0·001.

I applied the same process upon an extensive railroad in England, in the manufacture of coke, and obtained a great economy from the non-destruction of the fire-boxes and tubes by the sulphur. I also obtained at Manchester very satisfactory results, by employing coke thus prepared for the re-melting of iron in cubilot furnaces; the purified bars bearing 528 lbs., while the unpurified broke with 514 lbs.

For the Journal of the Franklin Institute.

Salt of Western Pennsylvania. By JAMES C. BOOTH and T. H. GARRETT.

The value of common salt for dairy purposes, preserving food, and for general use, and the singularly advantageous position of the salt springs or wells of Western Pennsylvania, issuing at the mouths of coal mines, led us to investigate the relative purity of some of the salt manufactured there, in comparison with foreign salt imported and largely employed on the coast. We subjected to analysis, Turk's Island, Liverpool ground Rock, and two samples of salt, coarse and fine, kindly furnished us by Mr. Lewis Peterson, of Salina Farm, near Tarentum, Pennsylvania, where and by whom the two samples were manufactured.

The following tabular arrangement of the results of analysis give a clearer comparative view of their relative purity and value:

	Chloride of Sodium.	Chloride of Magnesium.	Chloride of Calcium.	Sulphate of Magnesia.	Sulphate. of Lime.
Coarse, Tarentum, Penn.,	97·89	1·00	1·11	none.	trace.
Fine, " " "	98·87	0·51	0·62	none.	trace.
Liverpool ground Rock,	98·55	0·08	none.	0·16	1·21
Turk's Island, . .	93·85	3·47	none.	none.	2·68

Beside these, the Turk's Island contains a little sand, of which the others only contain traces. The difference between them is evidently that the impurities in the Pennsylvania salt are chlorides, and in the others, sulphates of lime and magnesia. Since the chlorides are easily removed by washing, it is evident that the Pennsylvania salt might be brought to a state of absolute purity, if it were desirable or necessary. The salt manufactured by Mr. Lewis Peterson, bears a close comparison with the Liverpool ground Rock, and his fine variety surpasses it. Both of his varieties are 4 or 5 per cent. purer than Turk's Island salt.

Hints on the Principles which should regulate the Forms of Ships and Boats; derived from original Experiments. By MR. WILLIAM BLAND, *of Sittingbourne, Kent.**

Continued from Vol. xxiv., page 420.

CHAPTER XX.—CONCLUSION.

Since curves must be substituted for the straight line in the forms of the bottoms of all vessels of speed, as proved (see experiments 33, &c., chapter VII.), and in consequence a keel is indispensable, the midship

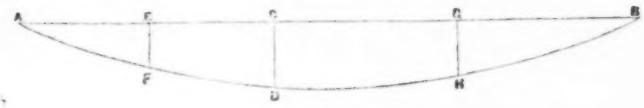
* From the London Civil Engineer and Architect's Journal, November, 1852.

section, but particularly the parts fore and aft of the same, will partake more or less of the elliptic and angle shape.

From experiments made subsequent to those already given in chapter XI., but not entered, and for the purpose of determining the perpendicular depth of the under-part of the keel at midships, from the load water-line of models with curved bottoms, it appeared that the depth to cause the greatest lateral resistance should not exceed the average breadth of half the beam measured at the points of equal distance between the midship and either end; unless the centre of gravity by means of heavy ballast, as lead, be made to descend proportionally with any addition to the depth of the keel.

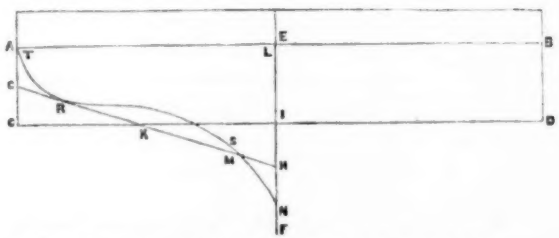
Again, as the above average depth is requisite for lateral resistance, then the midsip form, and likewise the sections towards both head and stern, must be moulded into those shapes which will meet the object desired, with the least increase of displacement beyond the true one the vessel ought to possess when required for speed, as in table 4, chapter XV.

Let the above be exemplified in the models O, Q, and R, and the diagram here annexed will assist in explaining the meaning.



No. 1. The Model O.—Scale $\frac{1}{2}$-inch to 1 inch.

A C B D represents the half part of the horizontal section of the model O, taken at the low water-line; C D being the midship, and E F, G H, the lines of the average beam.



No. 2. Midship Section of Model O.—Scale, 1 inch to 1 inch.

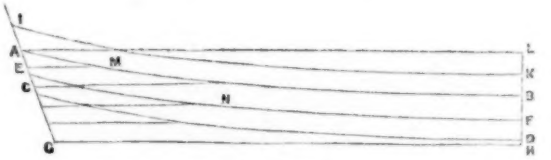
Let A B D C be the midship section of the model O, when with the flat bottom; L I the depth as stated in Table 4, Chapter XV. Now, in order to give speed to the model, the curved form must be applied to the bottom, which will cause the model to sink deeper into the water than before, by a one-fourth part of L I (see Chapter XVI.), or to the dotted line A E B.

Again, let E F equal the average breadth of beam, and F the bottom

of the keel; but as every increase of the displacement beyond A B D C, will retard speed; yet the part of the dead wood and keel from I to F, require support; it can only be carried into practice by transferring a portion of the capacity, or displacement at and about C, to between I and F. To this end, let K bisect the straight line C I, and G bisect A C from G, and draw through K the straght line G K H. By Euclid, the triangles G C K, K I H, are equal, therefore their displacements are equal. But since the keel from H to F, will likewise need support, a curved brace may be applied from M to N, which will, however, cause some addition to the capacity; or the curve T M N, may be substituted. To obviate the evil of additional capacity in some measure, the space may be filled with ballast, which, being situated low, will assist to compensate, by increasing the stability, and in consequence admit of an addition being made to the sail sufficient for the wind to impel forward the extra weight with nearly undiminished speed. The angle at G may be rounded off or not, but as it is, the original stability will be diminished by the removing of the triangle G C K, to the triangle K I H, because it is sufficiently evident on inspection that the assumed centre of the triangle K I H, from the perpendicular line E F, is less than R, the centre of the triangle G C K; therefore the power of buoancy to aid stability is proportionally reduced, and which will not be altogether met by the ballast in the triangles K I H, and M H N; the stability will again be lessened also, if the angle at G is rounded off.

No. 3. Bottom Curves of Model O.—Scale, ½-inch to 1 inch.

In this diagram (No. 3), A C is the load water-line, A B, B C, the bottom curves, and D E, E F, their union with the keel G H.



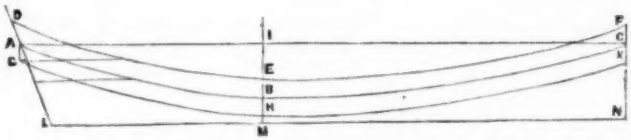
No. 4. Model O, from Head to Midship.—Scale, ½-inch to 1 inch.

Here is represented the part of the model situated between the head and the midship. A L the load water-line, A B the curve as A B in No. 3, B being the depth of E I in No. 2, and I K the curve at the depth of A G in No. 2, and C D the curve uniting with the keel G H. The curves I K, A B, C D, and the dotted one E F, are all parallel to each other, and which must be carried out along the bottom of the ship in planes perpendicular to the horizon, and parallel to the ship's longitudinal axis. With regard to the lines E M, C N, &c., they must be drawn parallel to the load water-line to form a wedge of the bows, as repeated

experiments, not entered, have determined this point over the bow curved alone; yet the outline of the said curve should be preserved wherever the lines touch, and made to take the concave form, with the express view of promoting speed, by assisting the raising of the bows over the waves, particularly of sailing vessels against the downward pressure of the wind on their canvass.

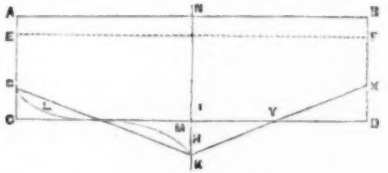
No. 4, *continued.*—Model O, from Midship Section to Stern.—Scale $\frac{1}{8}$ inch to 1 inch.

Let L A be the load water-line, B A, F E, D C, the curves, and D C the one uniting with the dead wood and keel. In this part of a ship no lines parallel with the load water-line are necessary, indeed they would be hindrances to speed, as has been shown already in the experiments. But in order to strengthen the dead wood and keel, short braces placed at the angle of 45° may be employed where thought requisite, but the less the better.



No. 5. Midship Section of Model Q.—Scale, $\frac{1}{8}$ inch to 1 inch.

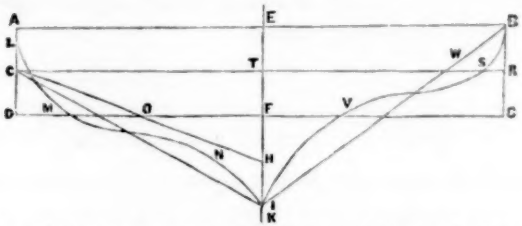
A I C is the load water-line, A B, B C, D E, E F, are the bottom curves, and G H, H K, the union with the keel L N; A R, G S, are parallel horizontal lines, as in No. 4, to form the wedge bow. The stern part, meaning from midship to stern, need not (as before stated) the horizontal parallel line, but the curved form preserved throughout. The concave of the horizontal lines, as mentioned in treating of the bows of the model O, cannot here be dispensed with.



No. 6. Model Q.—Scale, $\frac{1}{4}$ inch to 1 inch.

Let A B D C be the midship section of the model Q, A B the load water-line, the depth being increased from E F to A B, as in diagram No. 2. N K the depth equal to the average breadth of half the beam of the model Q, taken as in the model O. It is seen in this instance, that the depth from I to K, is less than in No. 2; therefore the bottom may be preserved flat at the midship, with a straight or curved bracket, as it were, to support the keel, and continued fore and aft; or it may at once

take the form as shown in the diagram by the letters H Y X, X D being taken equal to I H, when the triangles H I Y, X D Y, will be equal. Instead, however, of either of these, the outline may be as the curve G L M H.



No. 7. Midship Section of the Model R.—Scale, ¼ inch to 1 inch.

A B the load water-line, E T the depth of flotation, as in Table 4, Chapter XV., with the addition of one-fourth part of the $\frac{1}{16}$ths, in consequence of the curved bottom, making the total or one inch; which, according to the scale above is half an inch, or B R; therefore, A B R G represents the true displacement. E K is the half part of the average beam (see diagram R, in Experiment 83), in which the straight lines A B, D F, denote them; but they being drawn on the scale of $\frac{1}{8}$-inch to 1 inch, the average of the two, when doubled, will make it in the $\frac{1}{4}$-inch scale, as the diagram above, equal to E K, K being the bottom of the keel.

It appears upon the right-hand part of the diagram, that in order to support the necessary depth of keel, as T K, it must either have the timber of the bottom framed at midship, as in the dotted straight line I B, or in the curved one B S V K. If in the former, then the displacement will be doubled when completed on both sides of the model, and take proportionally from the speed, as recorded in Table 3, Chapter XV.; if the latter, still the original displacement will be increased, but not equal in degree to the former. The keel, however, cannot do without support; therefore, of the two evils, the latter must be preferred whenever speed is to be gained.

The form on the left-hand side of the diagram, comprehended and denoted by the curve L M N I, is graceful and effectual with regard to the keel; but then the displacement, even on inspection, exceeds more than double (it must be admitted) the true displacement required, and therefore will take too much from the speed, as evidenced in Table 3, Chapter XV., but would answer well if the vessel be intended for burthen instead of a yacht.

Further Observations.

In the models having their horizontal section at the load water-line, after the form of a bird or fish, as the sole, it is seen that the midship section or widest part, is situated at two-fifths of their length from the head, and three-fifths from the stern. This is Nature's law, in order to counteract and balance the extra resistance the forebody meets with against the air and water to what the aft body is subject. In Chapter III.

it is seen, when treating upon the law of lateral resistance, that when the model was drawn forward through the water, as well as sideways, the centre of lateral resistance, at the time, moved forward also; and the estimated proportion equalled one-twelfth the length of the model.

Let this result be compared with Nature's form. Take a model 28 inches long, its middle will then be 14 inches; divide 28 inches by 5, and the answer is $5\frac{1}{2}$ inches. Now two-fifths of 28 equals 11; and three-fifths equals $16\frac{1}{2}$; and 14 minus 11 equals 3, or 3 inches, which is the distance before the centre of length where Nature places her greatest width in birds, and in the sole fish. With the model in Chapter III. one-twelfth was the supposed place before the centre of length where the centre of lateral resistance resided when the body was moved both forward and sideways. The proportion of one-twelfth will be found to equal $2\frac{1}{4}$ inches, and rather more; being certainly less than 3 inches. It was stated, however, that increase of the speed of the model would cause the centre of lateral resistance to move still more forward. If granted, the average, allowing for mistakes, will be somewhere not far short of Nature's distance of 3 inches.

If the above statement be admitted near the truth, it follows, that whenever the line of greatest breadth of beam in a ship be situated aft the two-fifths of length, so as to destroy the balance of three-fifths of stern length, the evil must be compensated for, giving an equivalent in extra depth of keel towards and at the stern. Hence, the further aft the midship section be placed, the deeper must the keel be made, to preserve the due proportions of perpendicular surface of the two-fifths and three-fifths between the body before the midship and the body aft of the midship. Now, great depth of keel towards and at the stern is a serious evil in all ships destined for shallow waters, and is objectionable, in another point of view, as in respect of lee-way, on account of the greater power, from increased leverage, to overturn.

The forms of ships as regards beam to length, especially those for merchandise, should be regulated in a measure by the nature of the climate and sea in which they are destined to navigate. For, if to encounter stormy winds and seas, whose average continuance is above that in other climates and seas, their breadth of beam and angle projections ought to be strongly kept in view, and acted upon by the builders, to assist the stability. If, on the other hand, the winds and seas are comparatively moderate, less beam will be requisite, or greater length of vessel, and all angles dispensed with. Moreover, ships requiring much sail, in consequence of the breadth of beam, will need hands in proportion, to manage the same; which circumstance, being an item of increased expenditure, will ever have its weight with the owners of merchantmen. This does not apply, however, to men-of-war, whose hands are generally in sufficient number for all duties.

With the completion of these few hints, which have been derived from careful experiments, observations, and reflections, although upon a small scale, I now take my leave, sincerely hoping they will induce persons of far more competent abilities than I possess, to engage in making investigations upon a large scale, that the true principles of ship-building may no longer continue a mystery.

Successful Application of the Screw to a Ninety-Gun Ship, with Engines. By Messrs. John Penn & Son.*

The *Agamemnon*, 90, Captain Sir Thomas Maitland, C. B., when she went down the river on Friday afternoon, made a speed of upwards of 10 knots per hour until she arrived opposite Purfleet, when some small part of the engine, which had been made of hardened steel, and too tightly fitted, became suddenly hot and set fast, which caused the breakage of an eccentric band. This slight damage was made good, and the corresponding part of the engine ground, so as to prevent the possibility of its heating, and causing a similar accident. After the accident she was taken by the *Monkey* and *African* steam vessels to the deep water below Gravesend, where she anchored for the night.

On the following day (Saturday) she raised her anchor and started at 1 o'clock P.M., having on board Captain Sir Thomas Maitland; Commander Hall, who had joined on the previous day; Mr. Lloyd, chief engineer of the steam department at Somerset House; Mr. Trickett, assistant to the chief engineer at Woolwich Dockyard; Mr. John Penn, Mr. Hartree, and Mr. Matthew, of the firm that constructed her engines; Mr. Whitworth, engineer, Manchester; and Mr. F. P. Smith. The *Agamemnon*, in a few minutes after starting, began to draw the *Monkey* and *African* steam-tugs through the water; and it was amusing to witness the greatly increased rapidity of the engines of the smaller vessels when they were drawn by the screw steam-ship. When the *Agamemnon* arrived opposite the measured mile in Seareach the time was taken, and she accomplished the distance in 6 min. 24 sec., or at the rate of 9·375 knots, and the calculation gave her an average speed of upwards of 10½ knots per hour. As the *Agamemnon* proceeded onwards, her engines, of 600 horse-power, Messrs. Penn's patent trunk, worked in the most satisfactory manner, making 60 revolutions per minute without the slightest heating in any part. The cylinders of these magnificent engines are 78 inches diameter, equal to cylinders of 70¾ when the area of the trunk is deducted. The number of revolutions was from 58 to 60, or eight revolutions above the contract speed, and, notwithstanding this high velocity of engines of 3 feet 6 inches in stroke, not the slightest jarring in any of the fixed parts could be perceived, and the boilers supplied ample steam with moderate firing. The speed of the splendid screw steam-ship, drawing 17 feet 7 inches forward, and 20 feet 4 inches aft, propelled by a powerful screw of 18 feet diameter, with a pitch of 20 feet 6 inches, was the astonishment of all the captains and crews of the numerous sailing vessels coming up the river with the tide, and Mr. Stuart, the pilot of the *Agamemnon*, had a most difficult task to steer clear of them when tacking, as they thought they could cross her path in ample time, instead of which they had narrow escapes, and it was more owing to the excellent look-out of Mr. Bean, master of the *Fisgard*, and the care of the pilot, together with the admirable manner in which the engines could be stopped and set in motion, and the way in which she answered her helm, that her safe progress through so many vessels as

* From the London Mechanics' Magazine, October, 1852.

were in the reaches below Gravesend was accomplished without the least accident.

On reaching the Nore, the *Agamemnon's* boilers got clear of the mud, in some degree, which had passed into them while working in the basin at Woolwich. She left the tugs several miles behind her, and the fast steam-packet *Dryad*, belonging to the Woolwich Company, was at that time upwards of a mile astern, being unable to keep up with her. The *City of Canterbury*, a fast boat, on her passage to Herne Bay, had great difficulty in keeping up with the *Agamemnon;* and although the former had her foresails up, the *Agamemnon* kept ahead in fine style for upwards of three miles, until the *City of Canterbury* turned eastward for Herne Bay. Between the Nore and Mouse Lights, the speed of the *Agamemnon* was tried by Massey's patent log for half an hour, and found to be $10\frac{6}{10}$ knots, against a strong head wind, the engines making 58 revolutions, and the result was so satisfactory to Captain Sir Thomas Maitland and Mr. Lloyd, that they congratulated Mr. Penn on the success of the trial, which exceeded their most sanguine expectations. This fine vessel arrived and cast anchor near the *Waterloo*, 120, flag-ship at Sheerness, at half-past 4 o'clock, and all the officers and crews of the vessels afloat came on deck to witness her surprising speed. The Admiral's yacht *Triton*, came out to meet the *Agamemnon*, but was obliged to drop astern; although going at her utmost speed, the *Agamemnon* passed her, and she did not get into Sheerness till some minutes afterwards. It is understood that no further trial of the *Agamemnon* is considered necessary, until she is completely equipped and stored for sea. She is to mount a 10-inch gun on a traversing platform at her bows, and her other ninety guns will consist of long 32-pounders, of 56 cwt. each, and 32-pounders of 42 cwt., and she has ample room to work them with effect, should their services ever be required. Notwithstanding all the reports of the high performance of the *Napoleon*, French screw steamship of the same class, and about the same size as the *Agamemnon*, but fitted with engines of 1000 horse power, it is very questionable whether the *Agamemnon* will not, in all respects, equal her, although fitted with engines of comparatively much less nominal power, which do not occupy one-half the space, and probably do not weigh one-third of the *Napoleon's*.

Process for Imparting Greater Liveliness to Indigo-Blue in Stuffs.

By L. Guillouet.*

This discovery consists in exposing the stuffs colored with indigo to the pressure of steam at an elevated temperature.

The blue coloring matter of the indigo is insoluble, and in order to fix it upon the stuffs, it is necessary to deoxidize it with green vitriol and lime. By dipping the stuffs into a solution of deoxidized indigo, a darker or lighter color is obtained, according to the length of the immersion.

Indigo is also of a volatile nature, and this is in fact one of its characteristic properties. It occurred to me, therefore, to turn this property to account, by exposing the stuffs colored with indigo to the action of a

*From the London Chemical Gazette, No. 241

high temperature, under constant pressure in air-tight metallic vessels, strong enough to resist an internal pressure sufficient to act upon the molecules of the indigo to incorporate them with the fibres of the stuff, and thus produce a change in the physical constitution of the indigo.

The form of the vessels employed is immaterial, but they must be furnished with a safety-valve, and also with a cock, through which the atmospheric air may escape on the introduction of the steam.

The stuffs dyed with indigo are laid one upon another in the vessel in question upon a wooden pan, and enclosed in a cloth, which serves to prevent their coming in contact with the sides of the vessel, and also to absorb the moisture which is produced at the first introduction of the steam. The steam is then allowed to flow in at a pressure of from 2 to 6 atmospheres. After the lapse of about twenty minutes or half an hour, the cover of the apparatus is removed, and the stuffs taken out and left to cool, when they may be folded and packed.

This operation communicates a violet tinge to the color of the indigo, without in the least injuring the other true colors fixed on the stuff, which, on the contrary, become fuller and brighter. The web loses considerably in length in the operation, but the loss of breadth is scarcely perceptible; at the same time a thicker and finer texture and more body and softness are obtained.—*Schweig. Gewerbeblatt*, xi. p. 98.

For the Journal of the Franklin Institute.

The Reading Steam Forge.

We are pleased to record the opening of this establishment, which is creditable to the enterprise of our neighbors in Reading, and will doubtless be found highly advantageous to manufacturers in this and other cities. No locality can be found combining greater facilities for cheap execution of iron forgings, than the one selected for the works in question. It is in the midst of one of the richest iron districts of this State; and being on the line of the Philadelphia, Reading, and Pottsville Rail road, the great avenue for the coal trade of Pennsylvania, coal can be procured at a very low rate, while every facility is offered for the transportation of finished work to this city at all seasons of the year.

The main building is 260 feet, by 100 wide, and contains at present, three of Kirk's patent steam hammers (the heaviest weighing 26 cwt.,) intended for small work. For the heavier class of forgings, a Nasmyth steam hammer is now building, which is to have a five ton ram falling seven feet—one of the largest in the country. The company is also erecting a furnace and machine for the manufacture of locomotive wheel tires, a heavy shears and slotting machine, and a large lathe, (vertical,) suitable for boring heavy cranks, &c. At some future time it is intended, we believe, to put up a puddling furnace and rolls, so that all the processes of manufacture from the pig, will be carried on under the same supervision. The steam required for the engine and hammers is made entirely by the waste heat from the furnaces, over which the boilers are set. Coal brought direct from the mines, is deposited at the door by a branch from

the Reading road; and two other branch tracks traverse the building, so that a locomotive enters and is attached to the cars on which finished work has been deposited by the cranes. The economy resulting from these arrangements is obvious. The establishment is fully worthy a visit, as it combines the improvements made up to the present time in each department.

The New Patent Law of Great Britain. By John Henry Johnson, Solicitor and Patent Agent.*

This act having already made its appearance in full, in many of our contemporaries, we think our readers will derive more benefit from a general statement of the changes which it effects, and the machinery through which it acts, than from a mere copy of the act itself. This is the more obvious to us, as the act is by no means particularly clear to the comprehension even of those most accustomed to the construction of the statutes; and it would be still more unintelligible to the majority of our readers, who do not probably number amongst them many members of the legal profession. Hence, the following translation may perhaps be found worthy of acceptation:

Commissioners.—The Lord Chancellor, the Master of the Rolls, the Attorney and Solicitor Generals for England and Ireland, the Lord Advocate and Solicitor General for Scotland, and such other persons as her Majesty shall appoint, are to be "Commissioners of Patents for Invention;" any three of whom (the Lord Chancellor or Master of the Rolls being one) may act.

The commissioners are to have a seal of office, and are to make rules of practice, to report annually to parliament, and to appoint such clerks and officers as they may think proper.

Provisional Protection.—A petition, declaration, and provisional specification, very similar to the documents at present required on petitioning for letters patent, are to be left in the commissioners' office, and to be referred by them to one of the law-officers, who will have the power to call scientific assistance to his aid. If the law-officer approves of the title and provisional specification, both of which he can allow or require to be amended, he is to give a certificate of such approval or allowance, which is to be filed in the commissioners' office, whereupon the invention may, for six months from the date of the petition, be used and published without prejudice to any letters patent to be granted for the same. The entire expense of this proceeding, including agency, fees, &c., will probably amount to £10 10s. As the validity of the patent will principally depend upon this provisional specification, it will be necessary to frame it with the greatest care and consideration.

Instead of the proceeding last described, the applicant for letters patent may file, with his petition and declaration, in the commissioners' office, a complete specification of his invention; whereupon a certificate of the filing having been given him, the invention is protected for a period of six months, as before. Any letters patent granted, therefore,

* From the London Practical Mechanic's Journal, August, 1852.

are to contain a clause, conditioning them to be void if this specification does not fully describe the invention; a copy of the specification is to be open for public inspection from the time of its deposit. The commissioners are to cause these "protections" to be advertised as they may see fit. The expense of this protection will of course vary in every case, with the nature of the invention, and the amount of trouble or skill required in preparing the specification and drawings, if drawings are necessary: the actual payment to government will be £10.

Completion of the Patent.—When the applicant is desirous to complete his patent, after either of the preliminary steps before described, he is to give the commissioners notice to that effect; the application is then to be advertised, and parties desirous of opposing the grant are, within such time as the commissioners shall appoint, to leave with the commissioners notice in writing of their grounds of opposition. When the time for this purpose has expired, the applicant's provisional or complete specification, and the particulars of objection, are to be referred to the law-officer to whom the application has been referred; the law-officer is to decide upon the matter as he may think fit, and, if he deems it advisable, he has the power to decide by whom the costs of the application, reference, and hearing (if any) shall be paid. After the law-officer's decision, he is to issue his warrant for the sealing of the patent; the warrant is to be sealed with the commissioners' seal, and is to set out the clauses and restrictions to be contained in the grant. The same power is reserved to the Lord Chancellor as to the making and issuing of patents under this warrant, as he possesses under the present system; and power is also reserved to her Majesty, by warrant under her royal sign manual, to direct the law-officer to withhold his warrant, or to direct that no letters patent shall issue under his warrant, or to direct the insertion in the letters patent of any provisions or restrictions she may think fit, and also to direct any complete specification which may have been filed, to be cancelled, upon which the protection obtained shall cease.

The letters patent are to be void unless £50 be paid at the end of three years from the date thereof, and £100 further at the end of seven years. Certificates of these payments are to be issued under the commissioners' seal, and receipts therefor to be endorsed on the letters patent; such certificates to be legal evidence of the payments.

After the sealing of the warrant, and when required by the applicant, which must be within three months from the date of the warrant, the commissioners are to cause letters patent to be prepared, and the Lord Chancellor is to affix the great seal thereto; such letters patent extending to the United Kingdom of Great Britain and Ireland, the Channel Islands, the Isle of Man, and such of the Colonies as have been specially petitioned for, and are named in the warrant. These letters patent are to be of the same effect as the three distinct grants now are. One transcript of the letters patent is to be entered in the Records of Chancery in Scotland, in the same manner, and to the same effect, as letters patent for Scotland now are; and copies of, or extracts from, such transcripts are to be received as evidence in the Scotch law-courts, with the same effect as the letters patent themselves. Another transcript is to be transmitted for enrolment in the Chancery Enrolment Office in Dublin, and is

to have the same effect in Ireland as letters patent for that country solely now have. Letters patent are not to issue, unless granted during the period of preliminary protection already fully described, except in case application has been made to seal the letters patent, and such sealing has been delayed by reason of a caveat or application to the Lord Chancellor against their being sealed, or in case of the death of the petitioner during the continuance of the preliminary protection, under which circumstances the executors or administrators of the applicant may obtain the seal within three months after his decease.

Letters patent may be sealed as of the day of the date of the application, or in case of any invention protected under the "Protection of Inventions Act, 1851," the act passed for the protection of inventions exhibited at the 1851 Exhibition—as of the day of the provisional registration, or of the day of the sealing of the letters patent, or, in the discretion of the Lord Chancellor and the law-officer, of any other day between the day of application or provisional registration, and of sealing: but, *except in case a complete specification has been filed with the application*, no legal proceedings can be adopted for infringements committed before the patent was actually sealed. This is a very important provision, and for this cause it may be desirable, in some cases, to file a complete specification with the application.

Specifications.—Specifications are to be filed instead of being enrolled, and all provisional and complete specifications filed in the commissioners' office shall, immediately on the completion of the letters patent, and where no patent is issued, then within six months from the date of the application, be transferred to the office in Chancery, where specifications are to be filed. If drawings are alluded to in the specification, two copies of such drawings are to be left with the specification.

Copies of all specifications, disclaimers, memoranda of alterations and provisional specifications, after the expiry of the term of their provisional protection, are to be open for inspection at the office of the commissioners, and at offices in Edinburgh and Dublin.

Specifications, disclaimers, and memoranda of alterations, are to be printed and published, and sold as soon as conveniently may be after their being filed; and the commissioners may present copies thereof to such public libraries and museums as they may think proper, and the patentee may have twenty-five copies of such publications without any charge; and these copies, printed by the Queen's printer, are to be *prima facie* evidence of the existence of the originals in all law-courts. The proceedings now in operation, under the Acts 5 and 6 Wm. IV., c. 83, and 7 and 8 Vict., c. 69, as to disclaimers, memoranda of alterations and confirmations, are to be applicable to letters patent obtained under this act.

Registers.—The office in Chancery, where specifications are to be filed, is to keep a "Register of Patents," wherein will be recorded, in chronological order, all letters patent granted under this act, the deposit or filing of specifications, disclaimers, and memoranda of alterations, all amendments, all confirmations and extensions, the expiry, vacating or cancelling letters patent, with their dates, and all other matters affecting the validity of patents, as the commissioners may direct.

The same office is to keep a "Register of Proprietors," wherein is to be entered, as the commissioners shall direct, the assignment of any patent, or of any interest therein, any license, and the district to which it refers, with the name of any person having any interest in such patent or license, and the date of his acquiring the same, and any other matter relating to the proprietorship; and copies of such entries, certified under the seal of the office, shall be received as *prima facie* evidence of such transactions. Until such entries have been made, the original patentee is to be deemed the sole party interested. Duplicates of the entries in the "Register of Proprietors" are to be open for inspection in Edinburgh and Dublin.

Any person obtaining a false entry in the register of proprietors, is deemed guilty of a misdemeanor, and will be punished accordingly; and any person deeming himself aggrieved by any entry therein, may apply, by motion, to the Master of the Rolls, or to any of the courts of common law at Westminster, in term, or to a judge in vacation, for an order to expunge, vacate, or vary such entry, which may be ordered. We consider these provisions to be of great importance, as at present there is no method by which information as to dealings with patents can be obtained.

Patents for Foreigners.—Where an application is made under this act for the United Kingdom, in respect of any invention *first invented in any foreign country*, or by the subject of any foreign power or state, and a monopoly therefor has been obtained in any foreign country before the date of letters patent for the United Kingdom, the British patent is to become void immediately upon the determination of the foreign patent, or where several foreign patents have been obtained, upon the expiration of the first of such foreign patents; and no patent granted for an invention for which a patent has been obtained abroad, and has expired, is to be valid in the United Kingdom. This clause will render it very desirable for foreigners, or Englishmen resident abroad, to obtain their British patent before doing anything in the country where they are resident. We are afraid the alteration in this respect, which appears to be quite uncalled for, will be a source of great trouble to foreign patentees. No British patent is to extend to foreign ships within British ports, except in the case of ships belonging to foreign countries whose laws will prevent the use of their subjects' inventions by British ships whilst in the ports of such foreign countries.

As to Patents applied for before Passing of Act.—Patents may be granted on applications made before the passing of the act, as if the act had not passed; and where letters patent for England, or Scotland, or Ireland, have been granted before the passing of the act, or are in respect of any application made before the passing of the act, hereafter granted for any invention, letters patent for England, or Scotland, or Ireland, may be granted for such invention as if the act had not passed, except that, in place of the existing fees, there shall be paid for each country a sum equal to one-third of the total fees to be paid for the United Kingdom under this act.

Fees and Stamp Duties.—The under-mentioned fees and stamp duties are to be paid. The stamp duties are to be under the control of the

Commissioners of Inland Revenue, and the provisions of the present Stamp Acts are to be applicable thereto. The fees to be paid into the receipt of the Exchequer, and are to form part of the Consolidated Fund. The law-officers' fees, in cases of appeals, oppositions, disclaimers, and memoranda of alterations, are to be paid as heretofore, and the Lord Chancellor and the Master of the Rolls are to determine the fees to be paid the law-officers, and also the charges for office copies, certificates, &c., to be granted under this act.

Persons now holding offices abolished by this act are to be compensated.

Fees.	£	*s.*	*d.*
On leaving petition for grant of letters patent,	5	0	0
On notice of intention to proceed with the application,	5	0	0
On sealing of letters patent,	5	0	0
On filing specification,	5	0	0
At or before the expiration of the third year,	40	0	0
At or before the expiration of the seventh year,	80	0	0
On leaving notice of objections,	2	0	0
Every search and inspection,	0	1	0
Entry of assignment or license,	0	5	0
Certificate of assignment or license,	0	5	0
Filing application for disclaimer,	5	0	0
Caveat against disclaimer,	0	2	0
Stamp Duties.			
On warrant of law-officer for letters patent,	5	0	0
On certificate of payment of the fee payable at or before the expiration of the third year,	10	0	0
On certificate of payment of the fee payable at or before the expiration of the seventh year,	20	0	0

There are some clauses relative to legal proceedings upon letters patent, of which no abstract is given, as it is thought they would not be very intelligible to inventors and intending patentees, for whose information only we have prepared this abstract.

Summary of Chief Alterations.—In place of a separate, most expensive, and tedious process for each kingdom, one grant of letters patent will extend to the whole of the United Kingdom; and one specification only of the invention will have to be filed.

A preliminary protection will be given for a period of six months, at a slight cost, within which period an inventor will have the opportunity of publishing and of testing the actual merits of his invention.

Letters patent will be granted on a scale of fees payable at three periods—on obtaining the grant, at the expiration of three years, and at the expiration of seven years, instead of the total amount having to be paid on the commencement, as at present.

The practice is thus assimilated to that of the principal continental states, as the costs of obtaining protection are, as it were, proportioned to the success of the invention. For, if successful, or promising to be so, at the end of three years, the patentee will gladly pay the additional sum required; whereas, if unsuccessful, he very naturally will not.

On the Occurrence of Metallic Iron in Fossil Wood. *By* W. G. Lettsom, Esq.*

In the recent edition of Phillip's Mineralogy by Messrs. Brooke and Miller, at page 685, mention is made of the discovery of metallic iron in certain metamorphic rocks in Antrim by Dr. Andrews, of Belfast; and as this fact is a novel one, perhaps the following account of the occurrence of this substance in a metallic state in Sweden, translated from a periodical which appears here under the title of *El Restaurador Farmeceutico*, may be thought worthy of a place in the pages of the Philosophical Magazine.

M. Bahr, a pupil of Prof. Svanberg, has had occasion to analyze the fossil wood derived from an island in the lake of Ralang in Smaland, whose composition resembled that of the mineral known by the name of limonite.

On endeavoring to pulverize this mineral in small quantities, he observed some minute tenacious grains which yielded but very little to the action of the agate pestle. These grains were simply metallic iron; they became flattened by the blow of a hammer, were attracted by a magnet, and were soluble in acid with evolution of hydrogen.

M. Bahr enters upon the question, whether this iron had been formed in the mass of this wood by the reduction of some soluble salt of iron, or whether it has been originally introduced in the form of a nail, or the fragment of some tool or instrument, which, after having been partially destroyed by oxidation, may nevertheless have left some traces of its presence in the metallic state.

After having examined and discussed with care the origin, characters, structure, and composition of the specimen of fossil wood in question, M. Bahr arrives at the conclusion that the iron has been really deposited in the metallic state, and that the singular mineral submitted to his examination presents the first well-established instance of the occurrence of terrestrial native iron.

Among the points on which M. Bahr bases his opinion, may be cited the following:—

The specimen of fossil wood in question was detached on the 28th of August, 1798, from the thick end of the trunk of a tree that was met with on the floating island in the lake of Ralang in Smaland. This island, after being submerged for four years, had risen to the surface the evening before. At the end of the trunk there were two plates of copper, bearing an inscription commemorative of the date when Gustavus III. visited this singular island, which appears in its origin to have formed a tongue of land boarded over, which became detached from the mainland by the action of the waters of the lake. It is usually submerged, but from time to time it rises to the surface for a few days, most commonly in the months of August and September.

M. Bahr had submitted to him two specimens of this fossil wood, which in its external appearance very much resembled a fragment of limonite. The specific gravity of one of these fragments was 3·85, of the other only

* From the Lond., Edinb., and Dublin Philosoph. Magazine, November, 1852.

2·94. When the surface was brushed with the feathery part of a quill, metallic iron was rendered visible, penetrating the general mass of the wood in a pulverulent form, or in the state of scales and angular and rounded grains. This structure was more clearly seen by means of a magnifying glass or of a microscope, which showed the fibres of the wood separated by the pulverulent iron. Here and there these grains of iron were of an appreciable magnitude, and were joined together like beads in a rosary. A group of five such grains was about a millimetre in length. In other portions of the specimen they might be detached, leaving cavities resembling the organic cellules. The specific gravity of this iron (in consequence, probably, of its admixture with organic matters) is very inconsiderable. In two trials it was found to be 6·248 and 6·4972; in a third and last experiment instituted with a grain of iron flattened by the blow of a hammer, it was found to be 6·6255.

M. Bahr analyzed these grains of iron, having first freed them as much as possible from all organic substances, and the results that he obtained are stated below. The solution was effected by means of very dilute nitric acid, and the portion thus dissolved amounted to 80·16 per cent. of the total weight of the grains, and contained the following substances calculated in the form of oxides:—

Silica	0·818
Phosphoric acid	0·500
Nickel (and cobalt)	0·129
Lime and magnesia	0·178
Alumina	0·213
Vanadic acid	trace
Manganese	trace
Protoxide of iron (by difference)	98·171
	100·009

The residue, insoluble in very dilute nitric acid, contained also portions which obeyed the action of the magnet; and these in like manner were subjected to analysis, and gave the following results calculated in the state of oxides:—

Silica	0·619
Phosporic acid	3·159
Vanadic acid	1·102
Oxide of nickel (with oxide of cobalt)	0.737
Oxide of iron	94·464
Manganese	trace
	100.381

So far M. Bahr, the original source of whose paper I am unable to state, as it is not given in the Spanish version of it. In conclusion I may observe, that I possess in my collection of minerals a specimen of limonite from Passau in Bavaria, containing small threads and veins of iron in the metallic state.

Madrid, Sept. 23, 1852.

On the Production of Photographs on Glass. By J. Pucher.*

According to this process, a thin film of iodide of sulphur is formed upon plate glass, by covering the glass, which must be perfectly clean,

* From the London Chemical Gazette, August, 1852.

with a very thin coating of sulphur, and then impregnating this for a few seconds with the vapor of iodine. The glass plate is then placed in the camera, where at the same time the vapor of some quicksilver in an iron cup in the bottom of the camera acts upon the iodide of sulphur with which it is coated, and it receives the photographic image within a minute. The glass plate, when taken out of the camera, only exhibits a trace of the picture, but this immediately comes out on exposure to the action of the vapor of bromine. If the picture be now held over alcohol, and some of the same liquid be poured upon it, it will be fixed. Not more than from five to eight minutes are required for the whole operation.

The glass plates must be breathed upon and well rubbed with soft linen rag several times before use. They are coated with sulphur by burning sulphur sticks, made on purpose, in a proper tube, and holding the plates over it at a distance of about 3 inches. These sulphur sticks are prepared by dipping pieces of rush-pith into a melted mixture of sulphur and mastic, with which they become incrusted. For use, these sulphur sticks, which are about the size of a lucifer match, are stuck on a brass needle, introduced into the middle of a glass tube and kindled, so that the vapor of the sulphur may come in contact with the glass plate held over it.

These glass plates are so sensitive, that the coating of iodide of sulphur becomes instantly changed on exposure to direct sunlight, and give a Moser's image within five minutes when laid in a book. The figures thus obtained are most easily read by candlelight. In daylight, the blue letters can be recognised on the yellow ground only by looking through the plate towards the middle of the window, or towards a sheet of paper fastened in that place, the sulphur not having been removed either by vapor of bromine or by alcohol.

If a glass plate, covered with a solution of gum and exposed to the vapor of iodized sulphur, be placed in the camera, a positive picture, with all its details, is obtained, the outlines of which can be laid bare by an etching-point capable of scratching the glass. If a glass plate, so marked, be rubbed in with printing ink, the outlines will be filled, and the ink will remain in them when the glass is freed from the coating of gum by means of water. The picture is then easily transferred to paper, which is to be laid on the plate and rubbed over with a paper-knife.—*Archiv der Pharm.*, lxix. p. 301.

Extracts from Lectures on the Results of the Great Exhibition of 1851, *delivered before the Society of Arts, Manufactures, and Commerce, at the suggestion of His Royal Highness Prince Albert, President of the Society.**

I.—Sir Henry De la Beche.

1. *Amount of British Iron.*—The Exhibition may be said to have given rise to the most complete view of the iron produce of this country

* From the Edinburgh New Philosophical Journal, 1852.

which we possess. Mr. Samuel Blackwell, himself an ironmaster, accompanied the collection of iron ores by a statement of great value. He estimates the gross annual production of iron in Great Britain to be now upwards of 2,500,000 tons. Of this quantity, South Wales furnishes 700,000 tons; South Staffordshire, (including Worcestershire), 600,000 tons; and Scotland 600,000 tons. The remainder is divided among the various smaller districts. The iron of England and Wales was produced by 336 furnaces in blast in 1850. Though a considerable quantity of British iron is exported, a very large proportion remains to be variously employed in our own industry.

2. *Desilverizing of Lead.*—As to lead, the illustrations were chiefly British. There was an excellent exhibition of Pattinson's important process for desilverizing that metal—a process which has been of such service to lead-mining generally, rendering many lead-mines workable with profit which must otherwise have been abandoned. The chief ore whence lead is extracted is that known as galena, or the sulphuret of lead, furnishing from seventy-five to eighty-three parts of the metal, according to purity. It usually, though not always, contains silver in variable proportions. Upon the quantity of silver often depends the profitable raising of the ore. Previous to the invention of Mr. Pattinson, (of Newcastle-upon-Tyne,) about twenty ounces of silver in the ton of lead were required to render the extraction of that metal worth the cost; since then as little as three and four ounces in the ton of lead will repay extraction. Now, as so many ores contain small quantities only of silver, the importance of the process is evident. In a scientific point of view, it is one of much interest, as it consists in so conducting the work that portions of the lead can crystallize, by which the silver becomes excluded, in the manner in which, in many crystallizing processes, foreign substances are excluded during crystallization. Thus, by degrees, a mass of mixed lead and silver is left, extremely rich in the latter. When this richness in silver arrives at the point desired, that metal is extracted in the usual manner by cupellation. The lead-smelting at the Allenhead's mines, and at the Wanlockhead Hills, Dumfrieshire, both excellently displayed, are both founded on Pattinson's process. While touching on the Wanlockhead Hills exhibition, we should not pass over the arrangements by which the fumes from the furnace are prevented from escape, and from damage to the surrounding country, while lead, to the amount of thirty-three per cent. from the deposits or "fume," is obtained.

III.—Dr. Lyon Playfair.

1. *Iron Smelting.*—Let us select the smelting of Iron,* as an example of the teachings of chemistry. If practice, unaided by science, be sufficient for the prosecution of manufactures, this venerable art must be thoroughly matured, and science could scarcely expect to be of much use to it in its present state. But while we find much to admire in the triumphs of practical experience, there is yet great room for the improvement of this art. The cheapness of iron ore, and of the coal used in its smelting,

* Although the smelting of iron is not strictly within the division of Manufactures, according to the classification, its importance to this country will authorize an exception in its favor.

has been so great that, regardless of their capital importance to this country, we, like careless spendthrifts, use them without thought of the future.

The mode of smelting iron consists in mixing the ore with lime and coal; the former producing a slag or glass with the impurities of the ore, while the coal reduces the oxide of iron to its metallic state. Much heat is required in the process of smelting, but the cold air blown in, as the blast, lowers the temperature, and compels the addition of fuel, as a compensation for this reduction. Science pointed to this loss, and now the air is heated before being introduced to the furnace. The quantity of coal is wonderfully economized by this application of science; for instead of seven tons of coal per ton of iron, three tons now suffice, and the amount produced in the same time is nearly sixty per cent. Assuredly this was a great step in advance. Could science do more?

Professor Bunsen, in an inquiry in which I was glad to afford him aid, has shown that she can. We examined the furnaces, in each portion of the burning mass, so as fully to expose the operations in every part of the blazing structure. This seemingly impossible dissection was accomplished by the simplest means; the furnaces are charged from the top, and the materials gradually descend to the bottom; with the upper charge a long graduated tube was allowed to descend, and the gases streaming from ascertained depths were collected and analyzed. Their composition betrayed with perfect accuracy the nature of the actions at each portion of the furnace, and the astonishing fact was elicited, that, in spite of the saving produced by the introduction of the hot blast, no less than 81½ per cent. of fuel is actually lost, only 18½ per cent. being realized. If, in round numbers, we suppose that four-fifths of the fuel be thus wasted, no less than 5,400,000 tons are every year thrown uselessly into the atmosphere; this being nearly one-seventh of the whole coal annually raised in the United Kingdom. This enormous amount of fuel escapes in the form of combustible gases, capable of being collected and economized; yet in spite of these well-ascertained facts, there are scarcely half-a-dozen furnaces in the United Kingdom where this economy is realized by the utilization of the waste gases of the furnace.

Large quantities of ammonia are annually lost in iron smelting, which might readily be collected. Ammonia is constantly increasing in value, and each furnace produces and wastes at least 1 cwt. of its principal salt daily, equivalent to a considerable money loss. With the low price of iron, this subsidiary product is worthy of attention. As I write, a Welsh smelter has visited me, to say that he has adopted this suggestion with advantageous results. I might adduce other improvements introduced by chemistry in the smelting process; but these will suffice to show you that she has added to human power by increasing production, while she has also economized both the time and the materials employed.

On a new Yellow Dyeing Agent for Silk and Woolen, discovered by M. Guinon, of Lyons. *By* ROBERT WARINGTON.*

In the early part of last year, (March 2, 1851,) a specimen of a material for dyeing silk of a fine clear yellow color, without the aid of a

* From the London Chemical Gazette, July 15th, 1852.

mordant, was put into my hands for examination. It had been obtained in France, and was for the time supposed to be kept a secret. It was of the consistence of a soft extract, dissolved almost entirely in hot water, with the exception of a small quantity of brown resinous matter; and on the addition of a little tartaric acid, produced a fine clear yellow on silk by its being immersed in it for a short time; if a mordant be used, the color is much faster. This substance proved, on chemical examination, to be the picric, nitropicric or carbazotic acid in an impure state.

As the parties for whom the investigation was undertaken, wished to be informed as to a process for its manufacture, I made a series of experiments on this subject, and found that the action of nitric acid upon the resins of *Xanthorrhœa hastilis and X. arborea* afford an excellent product for this purpose. These gums are known in commerce, the first as gum-flavum, or yellow gum, and gum-acaroides, and that from the latter as black-boy gum, or grass-tree gum. The former was suggested some years since* by Dr. Stenhouse, as likely to prove the best source of carbazotic acid. As thus prepared, a very pure, dry, crystalline carbazotic acid is readily obtained, and at a very cheap rate, the resin yielding about half its weight of crude acid.

In October of last year, I made application, through Dr. Playfair, to the Industrial Exhibition, to endeavor to obtain a small specimen of these gums, as exhibited in the Australian department, for the purpose of identification, and to ascertain their value, but unfortunately without success, having received a polite note from the Executive Committee, stating that my application would be taken into consideration when all public institutions had been supplied. Failing in this direction, I have since been able to ascertain that it can at present be obtained in the drug market in small quantities at from 36*s.* to 40*s.* the cwt.; and I have also learnt, that if there were a sufficient demand, it could be imported at from 14*s.* to 20*s.* the cwt., making the cost of carbazotic acid about 6*d.* the pound.

I may state that I also communicated this investigation and process to Professor Magnus, of Berlin, during his sojourn in London in September, 1851, and have since forwarded him a small parcel of the resin.

The process employed in France has since been published by M. J. Girardin, of Rouen,† and consists in treating coal-tar with nitric acid. The price of the impure acid, as examined, is 25 francs the kilogramme, or about 9*s.* 6*d.* the pound avoirdupois.

Method of Crystallization by means of an uninterrupted Circulation. By M. Payen.‡

To procure substances in larger and more regular crystals than is possible by the ordinary processes, the author has made use of a very simple apparatus, in which a constant current is produced by a slight difference of temperature. An alembic is furnished at the top with a head, and

* Memoirs and Proceedings of the Chemical Society, vol. iii. p. 10.

† Journal de Pharmacie et de Chemie, vol. xx., Jan. 1852.

‡ From the London Chemical Gazette, July 15th, 1852.

both are filled with the substance to be dissolved. From the head a tube enters the top of a vessel standing beside it. A second tube goes from the base of this vessel into the alembic. All these vessels, alembic, head and supplementary vessel, together with the tubes, are filled with the solvent, and by heating the alembic on the water-bath by means of a spirit-lamp, a constant current is produced, in consequence of which, crystals, which gradually increase in size, are formed in the supplementary vessel. By treating sulphur and benzine in this manner, the author obtained octahedral crystals of sulphur of much larger size than by any other method.—*Comptes Rendus*, xxxiv. p. 578.

Analysis of a new Alloy for the Plates for Calico Printers. By Conrad Fischer.*

A white alloy, which is peculiarly adapted for the plates used in calico printing, and is used for that purpose in Ghent, has the following composition:—

Tin	46·81
Lead	37·44
Bismuth	15.75

Journ. für Prakt. Chem., lv. p. 192.

Electro-Metallurgy applied to Ornamentation of Glass, China, &c.†

Mr. John Ridgway, of Cauldon-place, Staffordshire, china manufacturer, has recently patented certain improvements in the method or process of ornamenting or decorating articles of glass, china, earthenware, or other ceramic manufactures. In the specification of his patent, just enrolled, Mr. Ridgway states that his first object is to apply a new glaze, which shall enable the metallic coating to adhere firmly, by capillary attraction, and give affinity for copper as a first coating. In pursuance of this, he first submits the article to an alcoholic solution, or a gelatinous solution. He then brushes over it an impalpable powder, composed of half carburet of iron, and half sulphate of copper. The article thus treated is then to be corroded by the fumes of hydro-fluoric acid. The article is then to be smoothed, by brushing it over with silver sand, or by the scratch-brush; but when the shape and nature of the article will not admit of this, it is to be plunged into a liquor, consisting of 6 quarts sulphuric acid, 4 quarts aquafortis, $\frac{3}{4}$ oz. muriatic acid, and 6 quarts water. Grease is to be carefully removed from the article, and a thin film of mercury is to be applied. The solution of copper consists of 1 sulphate of copper, and 4 filtered water. Suitable solutions for silvering or gilding are to be applied, in accordance with the practice of electrotyping. The claim is not to the solutions for coating as such, but to the application of "electrotyping," or electro-metallurgy, to the objects stated in the title, provided the articles be so prepared as to allow them to combine from an alloy with them.

* From the London Chemical Gazette, July 15th, 1852.

† From the London Railway and Commercial Gazette, No. 896.

*Improvement in the Production of the "Bleu de France" on Wool.**

The method at present in use for the production of "bleu de France" on wool, consists in boiling the wool in a bath containing ferridcyanide of potassium, an acid and chloride of tin, until the pure blue color is produced. In the course of this operation, much cyanogen escapes in the form of hydrocyanic acid. The loss of this substance, which is of so much importance in the formation of the blue color, led to the idea of altering the process as far as possible in such a manner as to retain the whole or greater part of the cyanogen in the bath, and precipitate it in combination with iron upon the fibres of the wool. Experiments undertaken with this view showed that this end can be attained by adding to the bath a salt of oxide of iron: the best is perchloride of iron. The dyeing takes place in the following manner:—The ferridcyanide of potassium is first dissolved in the bath; a small portion of the acid to be used is then added, and afterwards the chloride of tin and chloride of iron. The bath is now clear, and of a brownish color. The wool, well-washed and lukewarm, is then put in, and the whole heated to boiling. The wool immediately acquires a dark green color, and by boiling, after the addition of the remainder of the acid, becomes of a fine blue color.

The experiments made with this dyeing process gave favorable results in every instance. By its use a certain tone of color was produced with 25 per cent. less ferridcyanide of potassium than by the usual process.

Experiments made to determine the best proportion in which to add the chloride of iron, showed that an addition of chloride of iron (solution of iron in muriatic acid, into which chlorine was afterwards introduced, or which, after the addition of half as much more muriatic acid as was first employed, was treated with nitric acid), equal in weight to half or three-fourths of the ferridcyanide of potassium employed, produced the greatest effect, whilst a larger quantity gave a paler color. It is necessary to be cautious in adding the acid in this process, as less acid is sufficient here than in the usual method; tartaric acid gave the most favorable results. The ferridcyanide of potassium employed must of course contain no ferrocyanide, because, in this case, on the addition of the perchloride of iron, a precipitate of prussian blue would be formed. The compounds occurring in commerce can therefore be used only if they are quite free from admixture of this salt.—*Deutsche Musterzeit.*, 1851, No. 3; *Schweiz. Gewerbeblatt*, xi. p. 119.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 16, 1852.

John E. Addicks, President, pro. tem., in the chair.

George M. Conarroe, Recording Secretary, pro. tem.

The minutes of the last meeting were read and approved.

Donations were received from the Royal Cornwall Polytechnic Society, Falmouth; The Royal Astronomical Society, London; Hon. Joseph R.

*From the London Chemical Gazette, November 15th, 1852.

Chandler, U. S. Congress; John Wiley, Esq., New York; and from the Philadelphia, Germantown, and Norristown Railroad Company, and Messrs. E. D. Ingraham, Dr. John Redman Coxe, Frederick Graff, John W. Nystrom, and Geo. M. Conarroe, Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of November was read.

The Board of Managers and Standing Committee reported their minutes.

Resignations of Membership in the Institute (5) were read and accepted.

New candidates for Membership in the Institute (5) were proposed, and the candidates (120) proposed at the last meeting were duly elected.

Nominations were made for Officers, Managers, and Auditors, for the Institute for the ensuing year.

On motion, it was

Resolved, That the polls for receiving the votes of the Members at the annual election for Officers, Managers, and Auditors, for the ensuing year, to be held on Thursday, January 20th, 1853, be opened at 3 o'clock, and closed at 8 o'clock P. M.; and that a committee of seven members be appointed to receive the votes, and report the result thereof.

Dr. Rand called the attention of the members to specimens of engravings of fossils, medal ruled, on steel, from the original specimens. The plates accompany the report of the geological survey of Iowa, Illinois, Wisconsin, and part of Missouri, by Dr. David Dale Owen, U. S. Geologist, and were executed at his suggestion, by Mr. John M. Butler, of this City. By this process, a perfect fac simile of the original is obtained. Among the specimens exhibited were engravings of trilobites, ammonites, shell conglomerate, &c., of great beauty. Dr. R. mentioned that notwithstanding the perfect accuracy and beauty of the engravings thus produced, he had been informed that their cost was less than that of lithographs, in which it is necessary to depend upon the artist for the accuracy of the representation.

[We hope to present a more detailed account of this process, illustrated, in a future number of the Journal.]

A refracting pseudoscope, (Wheatstone's,) belonging to Prof. Frazer, was exhibited to the meeting, at the request of some of the members, by G. W. Smith.

An elevation of a building to be erected in Broad street, for the purpose of a shop, on an unusually large scale, and in a highly decorated style of architecture, was exhibited by Mr. George W. Smith, and the details described by him. It was designed by Mr. McArthur, of this city, and is almost two hundred feet in length, and upwards of one hundred feet in breadth, and about eighty feet high; consisting of three stories only, and nine windows front. The lower story is decorated with Corinthian columns, after the example of the temple of Jupiter Stator, at Rome, with the full enrichments.

The following minute of the November meeting having been omitted in its regular order, is now inserted.

Mr. G. W. Smith remarked that Mr. John C. Trautwine, C. E., had recently returned from an exploration of the canal route, spoken of by

Humboldt, as existing between the rivers Atrato and San Juan, in New Granada. The first of these rivers enters into the Atlantic, and the latter into the Pacific, about 400 miles apart by the windings of the rivers. Humboldt states that their waters were once united by a canal in the vicinity of the town of San Pablo. It appears, however, that this was never the case. Mr. T. ascended the Atrato to the head of canoe navigation, where he found at times but a few inches of water, and was compelled to assist in dragging his canoe along the stream in many places. He ran a line of levels from this head of canoe navigation, across to the San Juan, near San Pablo, and found the latter to be 102 feet below the former. The summit between them is 84 feet above the head of canoe navigation, and 186 feet above the ordinary water of the San Juan. The San Juan, at San Pablo, is 150 yards wide, and at its average stage, is 5 feet deep. Mr. S. had not time to go into the details of the impediments in the way of constructing a canal, but remarked that Mr. T. considered them entirely insuperable. Mr. T. also ascended the Napipi a few leagues, until he became convinced of its inapplicability for the purposes of a canal. He also traversed the country between the Atrato and the river Baudo, in two places; and descended the Baudo to its mouth, as well as the San Juan.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. Kingston Goddard's Patent Sectional Box and Axle.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, a "Patent Sectional Box and Axle," invented by Mr. Kingston Goddard, of Philadelphia, Pennsylvania—REPORT:

That the nature of the invention consists in making the box in two or more parts, with a recess to receive and embrace a collar on the journal part of the axle, or, what is essentially the same, with a projecting fillet to fit into a recess on the journal part of the axle. The box is fitted to the axle by having its periphery conical to fit and be drawn into the hub, or into a pipe-box fitted to the hub, so that by simply securing the box within the hub or pipe-box, which is done by means of a nut screwed on the end of the box, the wheel is secured on the axle.

The patentee claims for this arrangement the following advantages:—

1st, Its cost of manufacture is comparatively small.

2d, It is easily adjusted to new or old wheels.

3d, Smoothness and regularity of motion.

4th, Retention of oil or grease. The oil cannot escape from the outer end of the box, as that is secured by the nut; it has no tendency to flow out of that next the body of the vehicle, and it may be still further secured by making a groove in the box near its larger or inner end to receive a grummet placed on the axles. By removing a screw in the centre of the nut, fresh oil may be applied without removing the wheel from the carriage.

5th, Safety. There can be no running of the wheel off the axle.

6th, Ease with which it can be cleaned.

7th, It excludes entirely dust and sand.